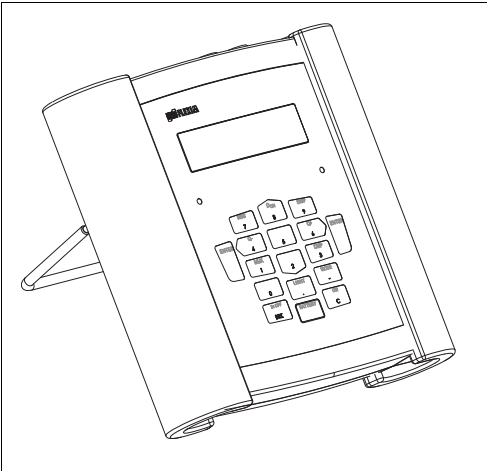
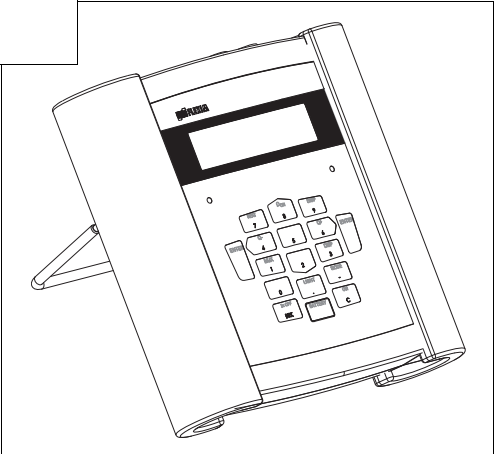


Ultrasonic Flowmeter for Gas



FLUXUS G601



FLUXUS G608

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User manual for

FLUXUS G60x

UMFLUXUS\_G6V4-2EN, 2011-03-29

Firmware V5.xx

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Die Sprache, in der die Anzeigen auf dem Messumformer erscheinen, kann eingestellt werden (siehe Abschnitt 10.4).

The transmitter can be operated in the language of your choice (see section 10.4).

Il est possible de sélectionner la langue utilisée par le transmetteur à l'écran (voir section 10.4).

El caudalímetro puede ser manejado en el idioma de su elección (ver sección 10.4).

De transmitter kan worden gebruikt in de taal van uw keuze (zie gedeelte 10.4).

Имеется возможность выбора языка информации, отображаемой на экран преобразователя FLUXUS (смотри подраздел 10.4).

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# 1 Introduction

## 1.1 Regarding this Manual

This manual has been written for the personnel operating the ultrasonic flowmeter FLUX-US. It contains important information about the instrument, how to handle it correctly, and how to avoid damages.

<b>Attention!</b>	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS_608).
-------------------	--

Read the safety Instructions carefully. Make sure you have read and understood this manual before using the instrument.

All reasonable effort has been made to ensure the correctness of the content of this user manual. However, If you find any erroneous information, please inform us. We will be grateful for any suggestions and comments regarding the concept and your experience working with the instrument.

This will ensure that we can further develop our products for the benefit of our customers and in the interest of technological progress. If you have any suggestions about improving the documentation and particularly this user manual, please let us know so that we can consider your comments for future reprints.

The contents of this user manual are subject to changes without prior notice. All rights reserved. No part of this manual may be reproduced in any form without FLEXIM's written permission.

## 1.2 Safety Instructions

The user manual contains instructions that are marked as follows:

<b>Note!</b>	This text contains important information about the use of the flowmeter.
--------------	--

<b>Attention!</b>	This text contains important instructions which should be observed to avoid damage or destruction of the flowmeter. Proceed with special caution!
-------------------	---



This text denotes instructions according to directive 94/9/EC.
--

Observe these safety instructions!

## 1.3 Warranty

The FLUXUS flowmeter is guaranteed for the term and to the conditions specified in the sales contract provided the equipment has been used for the purpose for which it has been designed and operated according to the instructions given in this User Manual. Misuse of the FLUXUS will immediately revoke any warranty given or implied.

This includes:

- replacement of a component of FLUXUS with a component that was not approved by FLEXIM
- unsuitable or insufficient maintenance
- repair of FLUXUS by unauthorized personnel

FLEXIM assumes no responsibility for injury to the customer or third persons proximately caused by the material owing to defects in the product which were not predictable or for any indirect damages.

FLUXUS is a very reliable instrument. It is manufactured under strict quality control, using modern production techniques. If installed as recommended in an appropriate location, used cautiously and taken care of conscientiously, no troubles should appear.

If any problem appears which can not be solved with the help of this manual (see chapter 22), contact our sales office giving a precise description of the problem. Specify the type, serial number and firmware version of the flowmeter.

## 2 Handling

### 2.1 First Inspection

The flowmeter has already been tested thoroughly at the factory. At delivery, proceed to a visual control to make sure that no damage has occurred during transportation.

Check that the specifications of the flowmeter delivered correspond to the specifications given on the purchase order.

The type and the serial number of the transmitter are shown on the nameplate. The transducer type is printed on the transducers.

### 2.2 General Precautions

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

FLUXUS is a precision measuring instrument and must be handled with care. To obtain good measurement results and not damage the instrument, it is important that great attention is paid to the instructions given in this user manual, particularly to the following points:

- Protect the transmitter from shocks.
- Keep the transducers clean. Manipulate the transducer cables with caution. Avoid excessive cable bend.
- Make sure to work under correct ambient and operating temperatures. The ambient temperature must be within the operating temperature range of the transmitter and the transducers (see annex B, section Technical Data).
- Use a correct external power supply when the transmitter is not used with the battery.
- Handle the battery charging unit and the battery correctly (see section 6.4 or 7.4).
- The power supply unit and the battery charging unit are not protected against moisture. Use them in dry rooms only.
- Observe the degree of protection (see annex B, section Technical Data).

### 2.3 Cleaning

- Clean the transmitter with a soft cloth. Do not use detergents.
- Remove traces of the coupling compound from the transducers with a soft paper towel.

## 2.4 Storage

- Wipe the transducers clean of traces of the coupling compound.
- After the measurement, always put the transmitter and its accessories into the corresponding compartments of the transport case.
- Avoid excessive cable bends, especially when closing the cover of the transport case.
- Observe the notes on the storage of the battery (see page 34 or 47).

## 3 Measurement Principle

### 3.1 Measurement System

With the clamp-on method, the ultrasonic transducers are mounted on the outside of the pipe. Ultrasonic signals are sent through the medium and received by the transducers. The transmitter controls the measuring cycle, eliminates the disturbance signals and analyzes the useful signals. The received measured values can be displayed, used for calculations and transmitted to a PC or printer by the transmitter.

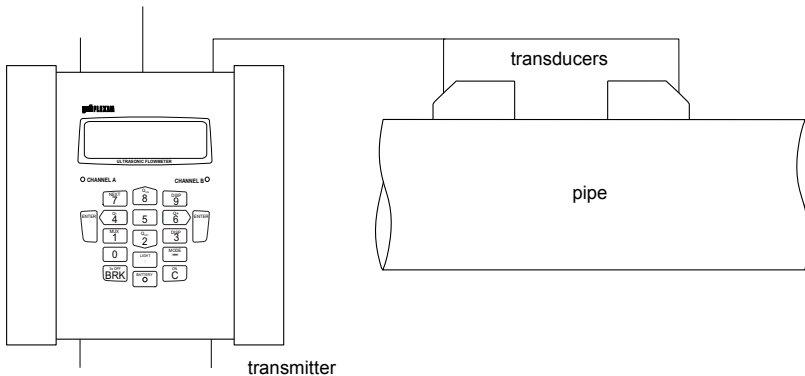


Fig. 3.1: Example of a measurement setup

### 3.2 Determination of the Volumetric Flow Rate

The flow velocity of the medium is measured using the transit time difference correlation principle. Further physical quantities (e.g. volumetric flow rate, mass flow) are derived from the flow velocity. The calculation is described below using the example of the volumetric flow rate.

The volumetric flow rate of the medium is calculated from the product of the flow velocity and the cross-sectional pipe area:

$$\dot{V} = v \cdot A$$

with

- $\dot{V}$  - volumetric flow rate
- $v$  - flow velocity
- $A$  - cross-sectional pipe area

The signals are emitted and received by two transducers alternatively in and against the flow direction. Because the medium moves, the signals propagating in the medium are entrained. Their transit time in the flow direction is shorter than against the flow direction. The transit time difference is proportional to the average flow velocity and therefore to the volumetric flow rate.

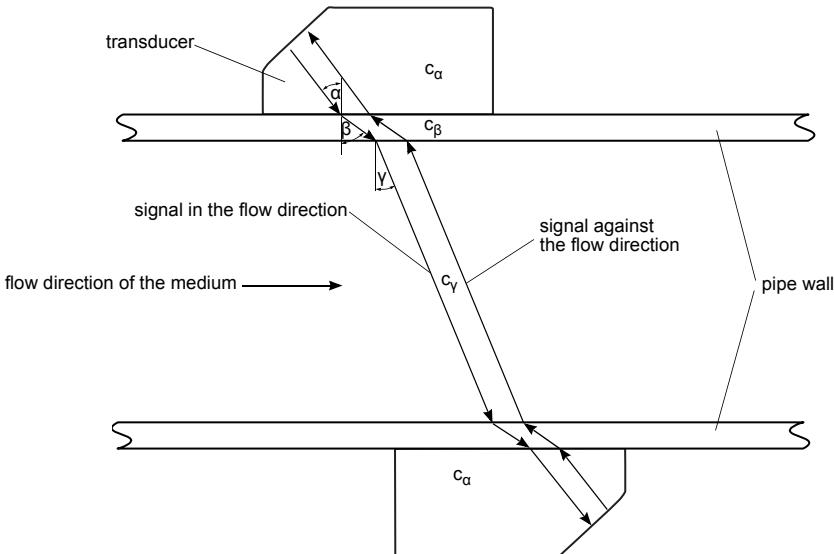
$$\dot{V} = k_{Re} \cdot k_a \cdot \Delta t / (2 \cdot t_{fl}) \cdot A$$

with

- $\dot{V}$  - volumetric flow rate
- $k_{Re}$  - fluid mechanics correction factor
- $A$  - cross-sectional pipe area
- $k_a$  - acoustic calibration factor
- $\Delta t$  - transit time difference
- $t_{fl}$  - transit time in the medium

With the fluid mechanics correction factor  $k_{Re}$ , the measured average value of the flow velocity along the measuring path is converted into the average value of the flow velocity across the cross-sectional pipe area. In case of an undisturbed flow profile, the fluid mechanics correction factor only depends on the Reynolds number and the roughness of the inner pipe wall. The fluid mechanics correction factor is recalculated for each new measurement.

The acoustic calibration factor  $k_a$  is calculated, according to the law of refraction, from the sound velocity inside the transducer and the angle with which the sound beam is transmitted into the pipe wall and then into the medium:  $k_a = c_\alpha / \sin \alpha = c_\beta / \sin \beta = c_\gamma / \sin \gamma$  (see Fig. 3.2). The acoustic calibration factor is constant for each transducer.



**Fig. 3.2: Measurement**

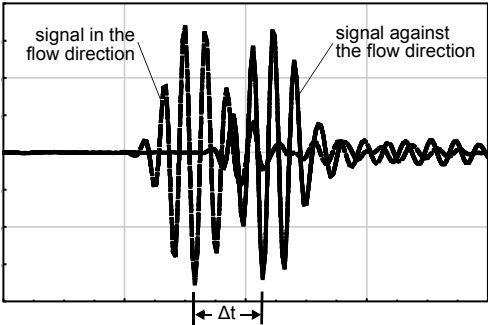


Fig. 3.3: Transit time difference  $\Delta t$

# 4 Transmitter

## 4.1 Design

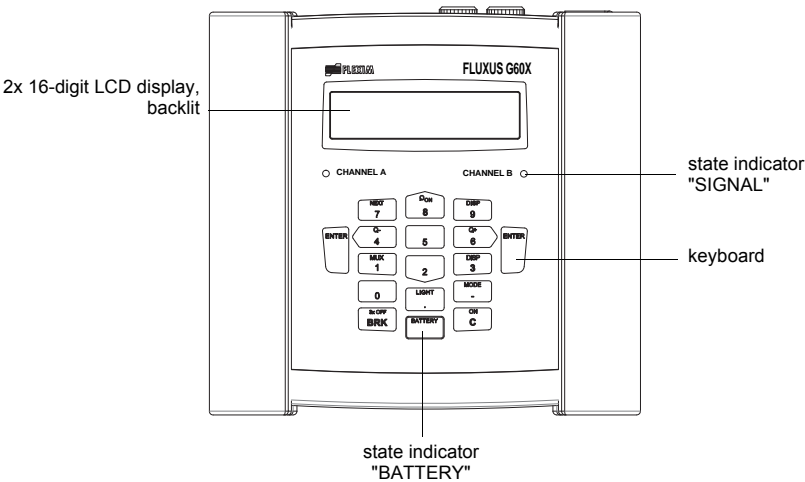


Fig. 4.1: Command panel

A handle is mounted to the back side of the transmitter (see Fig. 4.2). It can also be used as support. The aperture in the support plate is used to fix the transmitter to a pipe (see section 6.2.3).

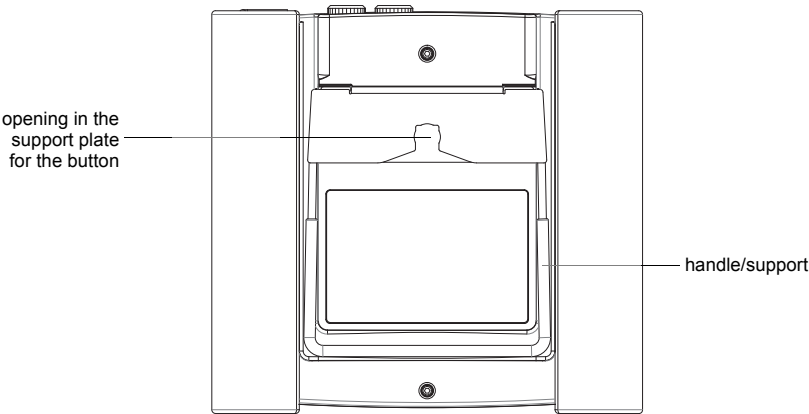


Fig. 4.2: Back side

## 4.2 Status Indication

**Tab. 4.1: LED "SIGNAL"**

LED off	transmitter offline
LED lights green	signal quality of the measuring channel sufficient for a measurement
LED lights red	signal quality of the measuring channel not sufficient for a measurement

**Tab. 4.2: LED "BATTERY"**

LED flashes green	battery is being charged
LED lights green	battery is charged
LED off	charge state of the battery > 10 %
LED flashes red	charge state of the battery < 10 %

<b>Note!</b>	If the LED "BATTERY" flashes red/green, the power supply has an internal error. Contact FLEXIM for more information.
--------------	--





## 4.3 Serial Number

The type and the serial number are shown on the nameplate of the transmitter. When contacting FLEXIM, always have both numbers and the number of the firmware version at hand (see section 17.6).

### 4.4 Keyboard

The keyboard consists of three function keys ENTER, BRK and C, the status indicator BATTERY and ten numerical keys.





Several keys have double functions. They can be used for entering data and for navigating through scroll lists.

The arrow-shaped keys , ,  and  are used as cursor keys in the selection mode and for entering digits and letters in the input mode.




Tab. 4.3: General functions

C	switching on the transmitter
LIGHT	switching on/off the backlight of the display
ENTER	confirmation of selection or of entered value
BRK + C + ENTER	RESET: Press these three keys simultaneously to correct a malfunction. The reset has the same effect as restarting the transmitter. Stored data are not affected.
BRK	interruption of the measurement and selection of the main menu Be careful not to stop a current measurement by inadvertently pressing key BRK!
BRK	switching off the transmitter by pressing key BRK three times









Tab. 4.4: Navigation

BRK	selection of the main menu
 	scroll to the left/right through a scroll list
 	scroll upwards/downwards through a scroll list
ENTER	confirmation of the selected menu item

Tab. 4.5: Input of digits

	input of the digit shown on the key
	sign for the input of negative values
	decimal marker
C	Delete values. After the value has been deleted, the previous value will be displayed.
ENTER	confirmation of input

**Tab. 4.6: Input of text**

 <b>4</b> 	positioning of the cursor
 <b>9</b>	changing the currently selected character to an "A"
 <b>3</b>	changing the currently selected character to a "Z"
<b>5</b>	changing between small and capital letters
 <b>8</b>  <b>2</b>	selection of the precedent/next ASCII character
<b>0</b>	deleting the character and inserting a blank
 <b>7</b> ...  <b>1</b>	Automatic scrolling up or down through the limited ASCII character set. The character changes every second. The scrolling is stopped by pressing any other key.
ENTER	finishing editing

**Tab. 4.7: Cold start**

BRK + C	<p>INIT (cold start): Most parameters and settings are reset to the factory default values. Stored data is not affected.</p> <p>Keep the two keys pressed while switching the transmitter on until the main menu is displayed.</p> <p>A cold start during operation is executed as follows:</p> <ul style="list-style-type: none"> <li>• Press the keys BRK, C and ENTER simultaneously. A RESET is executed.</li> <li>• Release key ENTER only. Keep the keys BRK and C pressed until the main menu is displayed.</li> </ul>
---------	---

## 5 Selection of the Measuring Point

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

The correct selection of the measuring point is crucial for achieving reliable measurement results and a high measurement accuracy.

A measurement on a pipe is possible if

- the ultrasound propagates with a sufficiently high amplitude (see section 5.1)
- the flow profile is fully developed (see section 5.2)
- the influence of noise is sufficiently low (see section 5.3)

The correct selection of the measuring point and thus, the correct transducer positioning guarantees that the sound signal will be received under optimum conditions and evaluated correctly.

Due to the variety of applications and the different factors that influence the measurement, there is no standard solution for the transducer positioning. The correct position of the transducers is influenced by the following factors:

- diameter, material, lining, wall thickness and shape of the pipe
- medium

Avoid measuring points in the vicinity of deformations and defects of the pipe and in the vicinity of welds.

Avoid locations with deposit formation in the pipe.

The ambient temperature must be within the operating temperature range of the transducers (see annex B, section Technical Data).

Select the location of the transmitter within cable reach of the measuring point.

The ambient temperature at the location must be within the operating temperature range of the transmitter (see annex B, section Technical Data).

If the measuring point is within an explosive atmosphere, the danger zone and gases that may be present must be determined. The transducers and the transmitter must be appropriate for these conditions.

### 5.1 Acoustic Penetration

The pipe must be acoustically penetrable at the measuring point. The acoustic penetration is reached when pipe and medium do not attenuate the sound signal so strongly that it is completely absorbed before reaching the second transducer.



The attenuation in the pipe and in the medium depends on:

- kinematic viscosity of the medium
- proportion of liquid and solids in the medium
- deposits on the inner pipe wall
- pipe material

The following requirements must be met at the measuring point:

- no material deposits in the pipe
- no accumulation of liquid (condensate), e.g. before orifice plates or at pipe sections located at lower levels

**Tab. 5.1: Recommended transducer mounting position**

<b>horizontal pipe</b>	
Select a measuring point where the transducers can be mounted on the side of the pipe, allowing the sound waves to propagate in the pipe horizontally. Thus, solid or liquid deposits on the bottom of the pipe will not influence the propagation of the signal.	
correct :	disadvantageous:
	

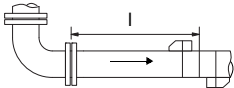
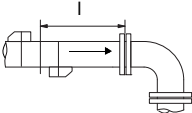
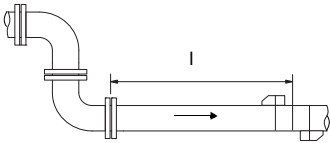
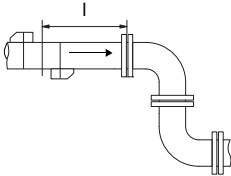
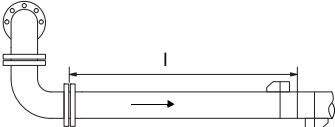
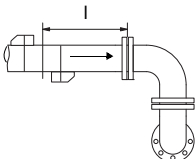
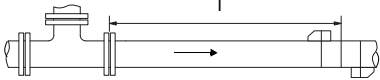
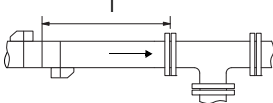
## 5.2 Undisturbed Flow Profile

Some flow elements (elbows, slide valves, valves, control valves, pumps, reducers, diffusers, etc.) distort the flow profile in their vicinity. The axisymmetrical flow profile needed for correct measurement is no longer given. A careful selection of the measuring point helps to reduce the impact of disturbance sources.

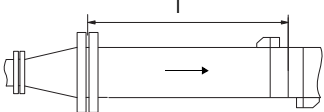
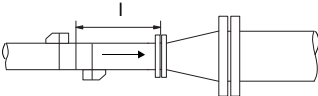
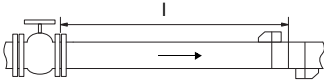
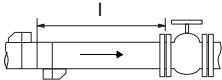
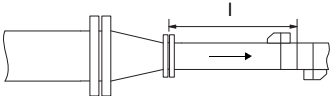
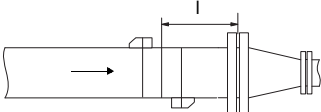
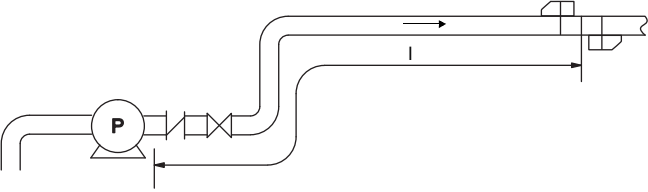
It is most important that the measuring point is chosen at a sufficient distance from any disturbance sources. Only then it can be assumed that the flow profile in the pipe is fully developed. However, measuring results can be obtained even if the recommended distance to disturbance sources can not be observed for practical reasons.

Recommended straight inlet and outlet pipe lengths for different types of flow disturbance sources are shown in the examples in Tab. 5.2.

**Tab. 5.2: Recommended distance from disturbance sources**  
**D = nominal pipe diameter at the measuring point, l = recommended distance**

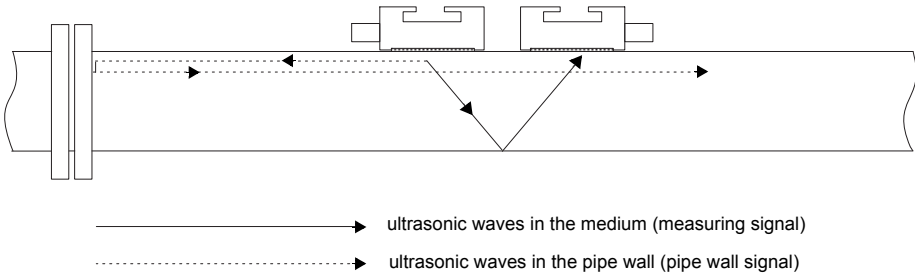
disturbance source: 90° elbow	
supply line: $l \geq 20 D$	return line: $l \geq 10 D$
	
disturbance source: 2x 90° elbows on same level	
supply line: $l \geq 50 D$	return line: $l \geq 10 D$
	
disturbance source: 2x 90° elbows on different level	
supply line: $l \geq 80 D$	return line: $l \geq 10 D$
	
disturbance source: T piece	
supply line: $l \geq 100 D$	return line: $l \geq 20 D$
	

**Tab. 5.2: Recommended distance from disturbance sources**  
**D = nominal pipe diameter at the measuring point, l = recommended distance**

disturbance source: diffuser	
supply line: $l \geq 60 D$	return line: $l \geq 10 D$
	
disturbance source: valve	
supply line: $l \geq 80 D$	return line: $l \geq 20 D$
	
disturbance source: reducer	
supply line: $l \geq 20 D$	return line: $l \geq 10 D$
	
disturbance source: compressor	
supply line: $l \geq 100 D$	
	

### 5.3 Influence of Noise

The ultrasonic waves do not only propagate in the medium but also in the pipe wall (see Fig. 5.1). They are reflected at flanges.



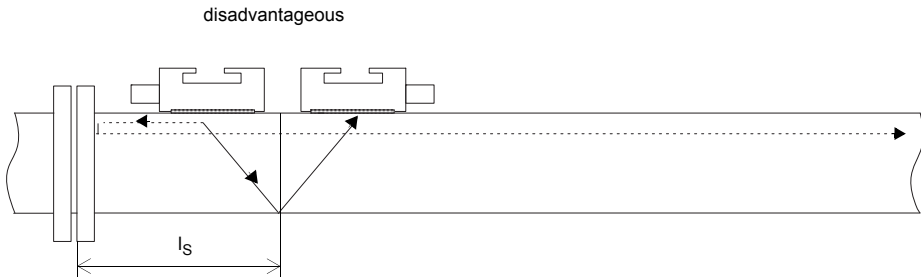
**Fig. 5.1: Propagation of ultrasonic waves**

The reflected pipe wall signals can disturb the measurement, especially if:

- the measuring point is close to the reflection point
- the pipe wall signals and measuring signals are received by the transducer at the same time

**Tab. 5.3: Measuring points to be avoided**

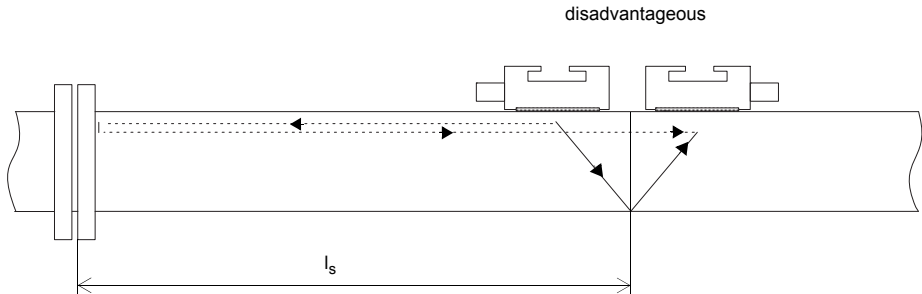
measuring point directly at the reflection point ( $l_s < 3 D$ ):



**Tab. 5.3: Measuring points to be avoided**

Measuring point at a distance of  $l_s \pm 2 D$  from the reflection point

Pipe wall signal and measuring signal are received by the transducer at the same time.



$$l_s = \frac{n}{2} \cdot \frac{c_P}{c_F} \cdot D$$

$l_s$  - distance to the reflection point

$D$  - outer pipe diameter

$c_F$  - sound speed in the medium

$c_P$  - sound speed in the pipe

$n$  - number of sound paths

example:

medium: natural gas

pipe material: stainless steel

$c_P$ : 3000 m/s

$c_F$ : 400 m/s

number of sound paths: 2

$l_s = 7.5 D$

The area  $(7.5 \pm 2) D$  is disadvantageous for the transducer installation.

## 5.4 Selection of the Measuring Point Taking into Account the Flow Profile and the Influence of Noise

- Select an area on the pipe where the flow profile is fully developed (see section 5.2).
- In this area, select the measuring point in such way that the influence of noise can be neglected (see 5.3).

**Tabelle 5.4**

example:medium: natural gas  
 pipe material: stainless steel  
 length of pipe segment 1: 20 D  
 length of pipe segment 2: 20 D  
 number of sound paths: 2

- area with developed flow profile:

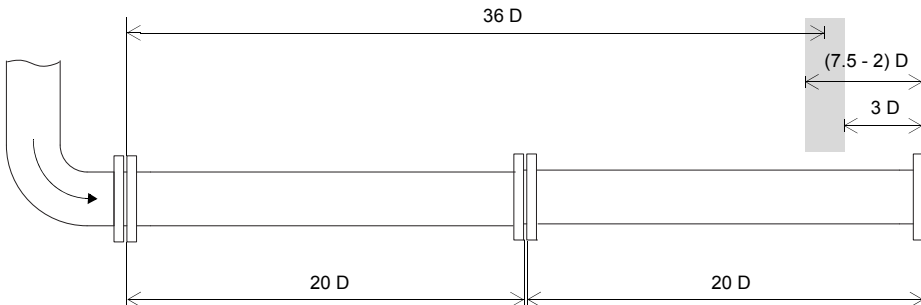
disturbance source: 90° elbow

recommended area for the measuring point:  $l \geq 20 D$  (complete pipe segment 2) (see Tab. 5.2)

- area with low influence of noise:

reflection point: flange

recommended area for the measuring point:  $l \geq 3 D$  and outside of  $l = (7.5 \pm 2) D$  on pipe segment 2 (see Tab. 5.2)



**Fig. 5.1: Area for the measuring point with a favorable flow profile and low influence of noise**

In consideration of the flow profile and the influence of noise, the measuring point can be selected in the area  $3 \dots (7.5 - 2) D$  on the right side of pipe segment 2 (with max. distance from the elbow). In the example, a distance of 36 D from the elbow was selected.

It is not always possible to meet both requirements at the same time. In these cases, the measuring point has to be selected in such way that the influence of noise is min. and the measuring point is as far from the disturbances of the flow profile as possible.

### Tabelle 5.5

example:medium: natural gas  
 pipe material: stainless steel  
 length of pipe segment 1: 20 D  
 length of pipe segment 2: 5 D  
 number of sound paths: 2

- area with developed flow profile:

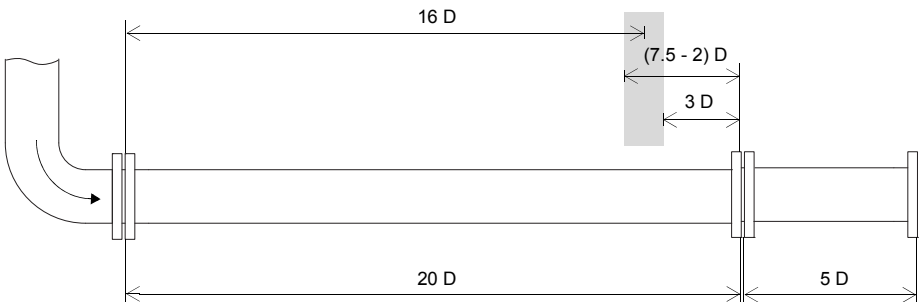
disturbance source: 90°-Krümmer

recommended area for the measuring point:  $l \geq 20 D$  (complete pipe segment 2) (see Tab. 5.2)

- area with low influence of noise:

reflection point: flange

recommended area for the measuring point:  $l \geq 3 D$  and outside of  $l = (7.5 \pm 2) D$  on pipe segment 1 (see Tab. 5.2)



**Fig. 5.1: Area for the measuring point with low influence of noise and not fully developed flow profile**

In the example, there is no area where both demands are met at the same time. The measuring point has to be selected as far as possible from the elbow, at a point where the influence of noise can be neglected:  $3 \dots (7.5 - 2) D$  on the right side of pipe segment 1. In the example, a distance of 16 D from the elbow was selected.

## 6 Installation of FLUXUS G601

### 6.1 Location

Select the measuring point according to the recommendations in chapter 4. The ambient temperature must be within the operating temperature range of the transmitter and the transducers (see annex B, section Technical Data).

### 6.2 Installation of the Transmitter

#### 6.2.1 Placement

Push the support back to the stop of the support plate.

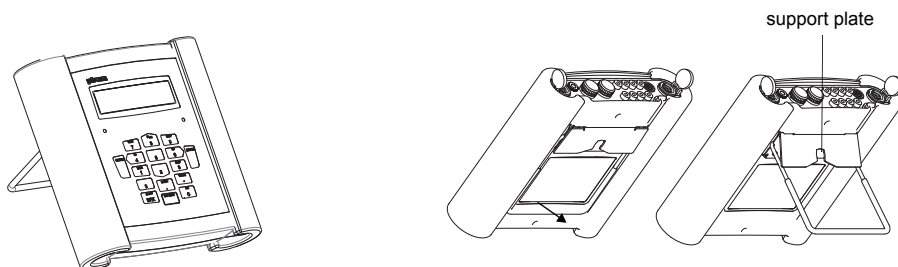


Fig. 6.1: Placement of the transmitter

#### 6.2.2 Hanging

Press both ends of the handle outwards and pass them past the support plate. Turn the handle upwards.

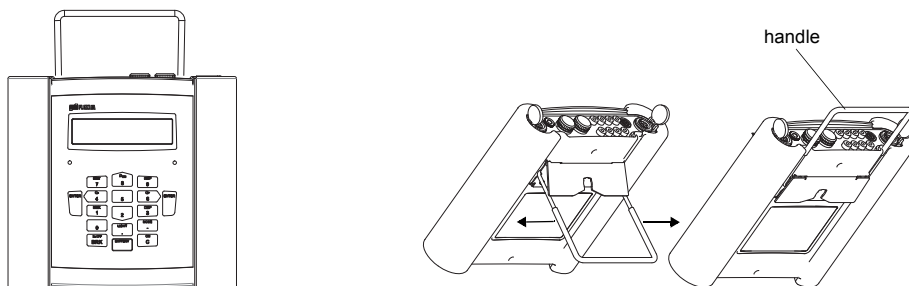
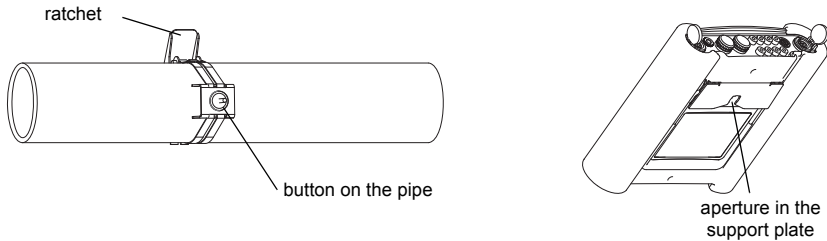


Fig. 6.2: Hanging of the transmitter

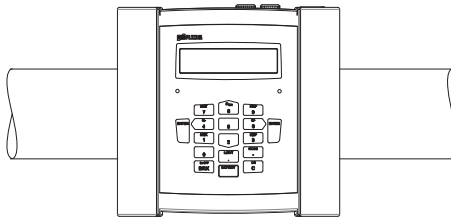
### 6.2.3 Installation on a Pipe

**Attention!** The pipe temperature must not exceed the operating temperature of the transmitter.

Fix the tension belt with the button to the pipe. Tighten the tension belt by means of the ratchet. Insert the button into the aperture of the support plate on the back side of the transmitter (see Fig. 6.3 and Fig. 6.4).



**Fig. 6.3: Pipe installation**

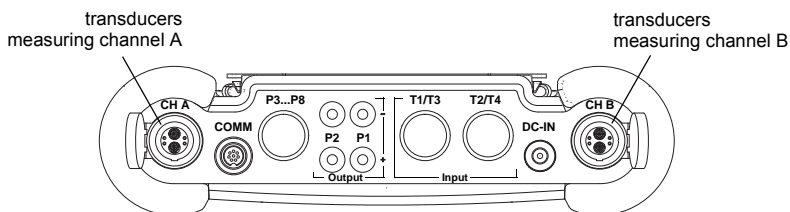


**Fig. 6.4: Transmitter on the pipe**

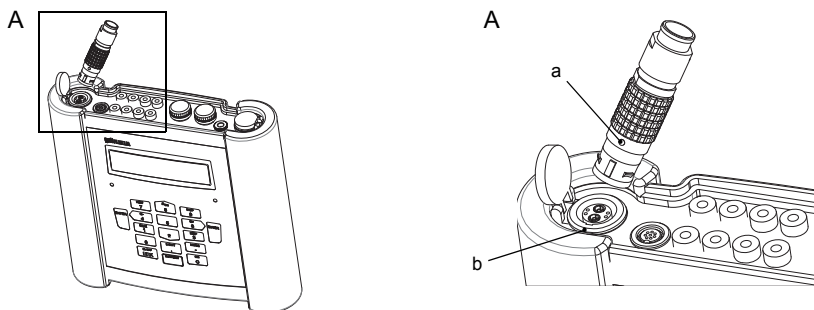
### 6.3 Connection of the Transducers

The connections are on the upper side of the transmitter (see Fig. 6.5).

- Pull up the socket cover (see Fig. 6.6).
- Insert the connector of the transducer cable in the socket of the transmitter. The red point (a) on the connector must align with the red marking (b) on the socket.



**Fig. 6.5: Connections of the transmitter FLUXUS G601**



**Fig. 6.6: Connection of the transducers**

## 6.4 Power Supply

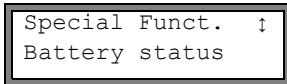
The transmitter can be operated with the battery (see section 6.4.1) or with the power supply unit (see section 6.4.2).

### 6.4.1 Operation with the Battery

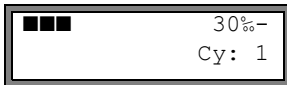
The transmitter has a Li-Ion battery and can be operated independently of the power supply unit.

At delivery, the battery is charged approx. 30 %. The battery does not need to be fully charged before it is used for the first time.

The charge state of the battery can be displayed during the measurement (see section 10.3) and in the program branch Special Funct.:



Select Special Funct.\Battery status. Press ENTER.



The current charge state of the battery is displayed (here: 30 %).

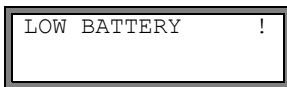
The minus sign "-" indicates that the transmitter is in battery mode and is being discharged.

The number of cycles the battery has passed is displayed after Cy: .

A cycle corresponds to a charging and discharging process. The life time of the battery can be derived by means of this value.

If RELEARN is displayed in the lower line and a question mark "?" is displayed in front of the current charge state, a relearn cycle should be started (see section Maintenance on the following page).

This message will be displayed if the battery is almost empty:



The capacity is sufficient for the display and storing of the current parameter record. A measurement is not possible anymore.

### Charging the Battery

Connect the power supply unit to the transmitter (see Fig. 6.7). Switch on the transmitter. The charging starts automatically. The LED "BATTERY" flashes green while charging. The max. charging time is approx. 5 h.

During the charging process, the ambient temperature should be in the range 0...60 °C.

A measurement can be made during the charging. Charging will be stopped automatically when the battery is fully charged. The LED "BATTERY" will light green.

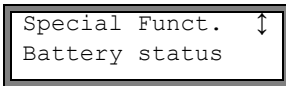
## Storing the Battery

The battery remains in the transmitter. After storage, the transmitter can immediately be operated with the battery.

- charge state: > 30 %
- storing temperature: 12...25 °C

## Maintenance (Relearn Cycle)

The accuracy of the displayed value for the charge state of the battery is improved by executing a relearn cycle. The ambient temperature during a relearn cycle should be in the range 12...30 °C.



Select Special Funct.\Battery status. Press ENTER.



The charge state of the battery is displayed (here: 73 %).

The "?" and RELEARN indicate that the displayed charge state is not reliable. A relearn cycle is recommended.

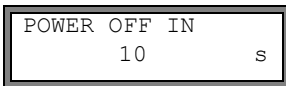
Proceed as follows for a relearn cycle:

- Charge the battery completely. The LED "BATTERY" lights green when charging is finished.
- Discharge the battery completely: Remove the power supply unit from the transmitter. To deactivate the automatic power off during discharging, start a measurement. Discharging takes min. 14 h. The LED "BATTERY" will flash red afterwards.

## Automatic Power Off

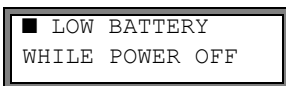
In the battery mode, the transmitter has an automatic power off. The transmitter will be switched off if

- no measurement is being made and no key is pressed in 10 min or
- the battery is empty



This message will be displayed before the transmitter is switched off automatically. A countdown with an acoustic signal will be started.

The countdown can be stopped by pressing any key.



If this message is displayed when the transmitter is switched on, the transmitter has been switched off automatically due to a too low charge state.

## 6.4.2 Operation with the Power Supply Unit

### Attention!

- Use only the supplied power supply unit.
- The power supply is not protected against moisture. Use it only in dry rooms.
- The voltage indicated on the power supply unit must not be exceeded.
- Do not connect a defective power supply unit to the transmitter.

- Connect the power supply unit to the socket on the upper side of the transmitter (see Fig. 6.7).

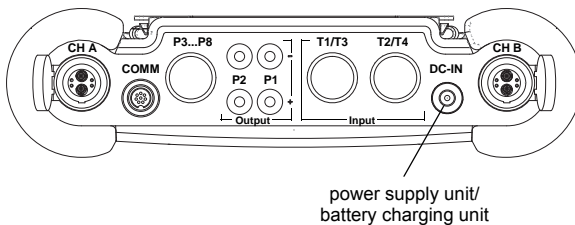


Fig. 6.7: Connections of the transmitter FLUXUS G601

## 6.5 Connection of the Outputs

For the connection of the outputs, see Fig. 6.8 and Tab. 6.1.

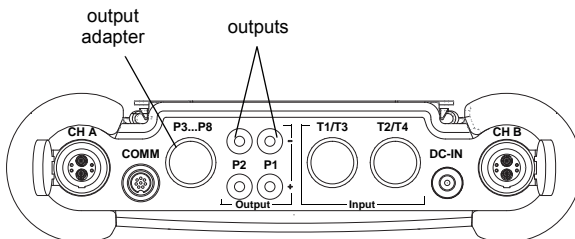
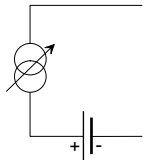
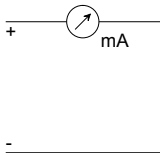
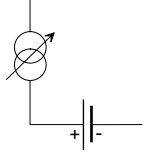
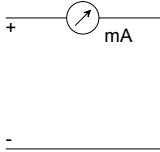
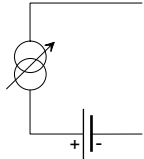
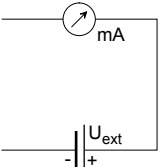
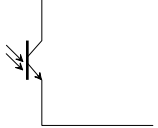
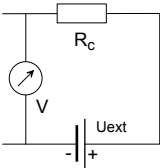
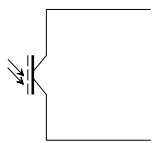
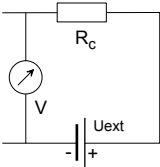


Fig. 6.8: Connections of the transmitter FLUXUS G601

**Tab. 6.1: Circuits of the outputs**

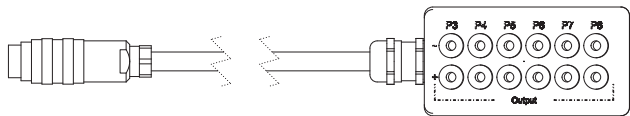
output	transmitter internal circuit	connection	external circuit	remark
active current loop		Px+  Px-		$R_{ext} < 200 \, \Omega$
passive current loop (semi-passive design, used as active current loop)		Px+  Px-		$R_{ext} < 50 \, \Omega$ e.g. for local connection of a multimeter
passive current loop (semi-passive design)		Px+  Px-		$U_{ext} = 4...16 \, V$ $U_{ext} > 0.021 \, A \cdot R_{ext} [\Omega] + 4 \, V$ example: $U_{ext} = 12 \, V$ $R_{ext} = 0...380 \, \Omega$
frequency output		Px+  Px-		$U_{ext} = 5...24 \, V$ $R_c [k\Omega] = U_{ext}/I_c [mA]$ $I_c = 1...4 \, mA$
binary output (optorelay)		Px+  Px-		$U_{ext} \leq 26 \, V$ $I_c \leq 100 \, mA$

The number, type and connections of the outputs are customized.

$R_{ext}$  is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/volt-meter).

**Connection of an Output Adapter**

The number of outputs can be increased to max. 8 by connecting an output adapter (optional) (see Fig. 6.8 and Fig. 6.9).



**Fig. 6.9: Output adapter**

## 6.6 Connection of the Inputs

### 6.6.1 Connection of a Temperature Input

Temperature probes Pt100/Pt1000 (4-wire) can be connected to the inputs of the transmitter (optional) (see Fig. 6.10).

For the assignment and the activation of the temperature inputs see chapter 20.

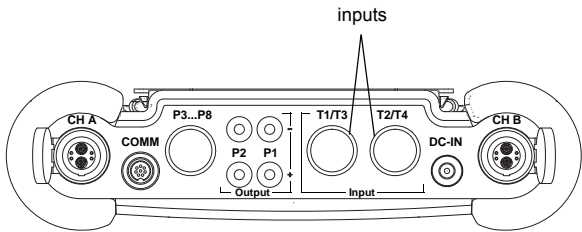
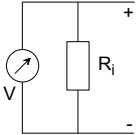
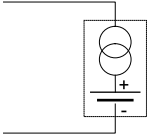


Fig. 6.10: Connection of the transmitter FLUXUS G601

### 6.6.2 Connection of a Passive Current Input

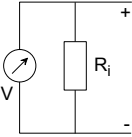
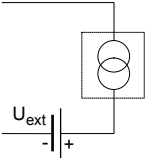
An active or a passive current source with an external power supply can be connected to a passive current input.

Tab. 6.2: Connection of an active current source

input	transmitter		external circuits	note
	internal circuits	connection		
passive current input		<div>+</div> <div>-</div>		max. permanent overcurrent: 40 mA

If the polarity of the current source is inversed, only the sign of the measured current will change.

Tab. 6.3: Connection of a passive current source

input	transmitter		external circuits	note
	internal circuits	connection		
passive current input		<div><div>+</div><div>-</div></div>		short circuit current: max. 40 mA

An external voltage source  $U_{ext}$  is necessary. It must provide a current of min. 20 mA and

- supply sufficient power for the energy requirements of the passive current source and
- cover the voltage drop at the input resistor (1 V at 20 mA) and
- cover all other voltage drops (e.g. cable resistance) in the circuit.

example: A passive current source (e.g. a pressure sensor) is to be connected to a passive current input.

Technical data of the pressure sensor:

$U_S = 11...30\text{ V DC}$   
 $I_a = 4...20\text{ mA } (I_{a\text{ max}} = 22\text{ mA})$

$U_{ext}$  required for the operation of the passive pressure sensor is:

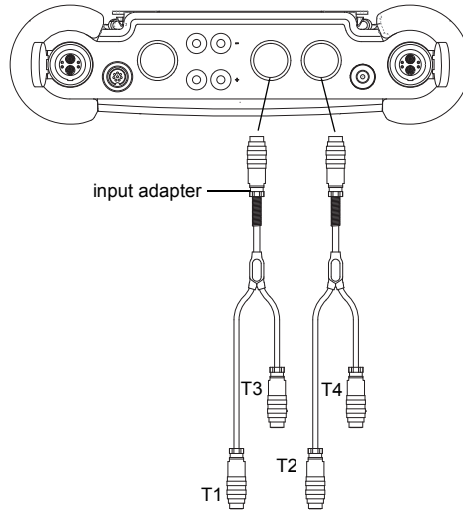
$$\begin{aligned} U_{ext\text{ min}} &= U_{S\text{ min}} + I_{a\text{ max}} \cdot R_i + I_{a\text{ max}} \cdot R_c \\ &= 11\text{ V} + 22\text{ mA} \cdot 50\text{ }\Omega + 20\text{ mA} \cdot 2\text{ }\Omega \\ &= 12.14\text{ V} \\ U_{ext\text{ max}} &= U_{S\text{ max}} \\ &= 30\text{ V} \end{aligned}$$

- $U_S$  - operating voltage of the pressure sensor  
 $I_a$  - output current  
 $R_i$  - input resistance  
 $R_c$  - cable resistance

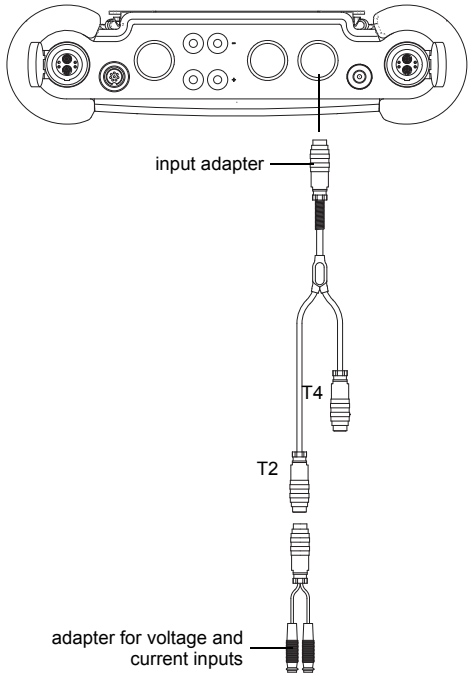
### 6.6.3 Input Adapter

The number of temperature inputs can be increased to max. 4 by means of 2 input adapters (optional) (see Fig. 6.11).

If the transmitter has voltage or current inputs, the adapter for voltage and current inputs will be used (see Fig. 6.12).



**Fig. 6.11: Connection of the input adapters**

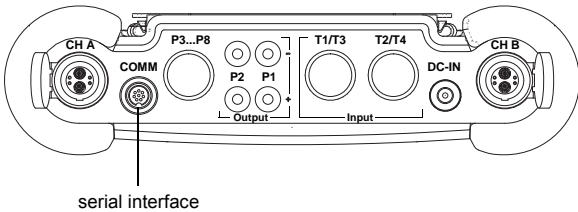


**Fig. 6.12: Connection of the adapter for the voltage and current inputs**

## 6.7 Connection of the Serial Interface

- Connect the RS232 cable to the transmitter (see Fig. 6.13) and to the serial interface of the PC. If the RS232 cable can not be connected to the PC, use the RS232/USB adapter.

The RS232 adapter, the RS232 cable and the RS232/USB adapter are part of the serial data kit (optional).



**Fig. 6.13: Connections of the transmitter FLUXUS G601**

## 7 Installation of FLUXUS G608

### 7.1 Location

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

Select the measuring point according to the recommendations in chapter 4. The ambient temperature must be within the operating temperature range of the transmitter and the transducers (see annex B, section Technical Data).

### 7.2 Installation of the Transmitter

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

#### 7.2.1 Placement

Push the support back to the stop of the support plate.

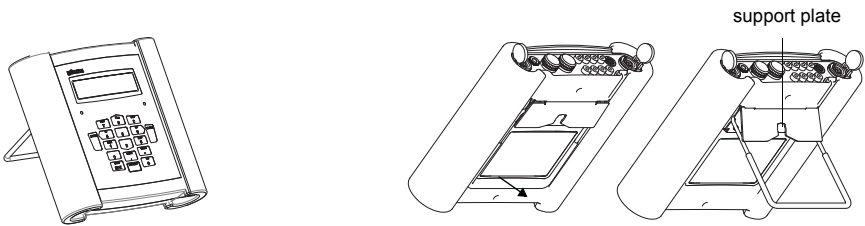


Fig. 7.1: Placement of the transmitter

#### 7.2.2 Hanging

Press both ends of the handle outwards and pass them past the support plate. Turn the handle upwards.

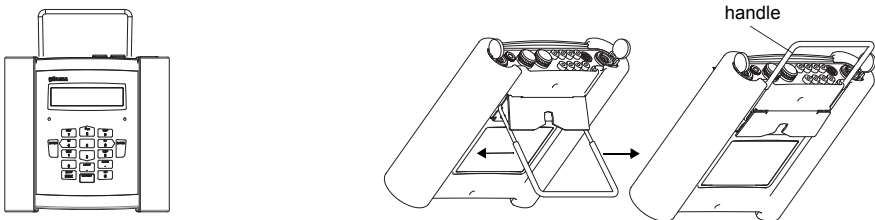
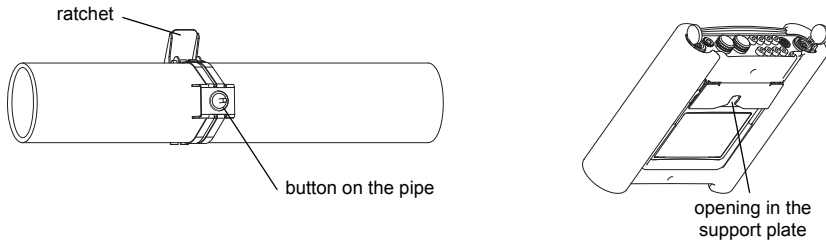


Fig. 7.2: Hanging of the transmitter

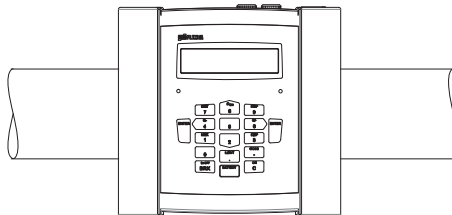
### 7.2.3 Installation on a Pipe

**Attention!** The pipe temperature must not exceed the operating temperature of the transmitter.

Fix the tension belt to the pipe with the button. Tighten the tension belt by means of the ratchet. Insert the button into the opening in the support plate on the back side of the transmitter (see Fig. 7.3).



**Fig. 7.3: Pipe installation**



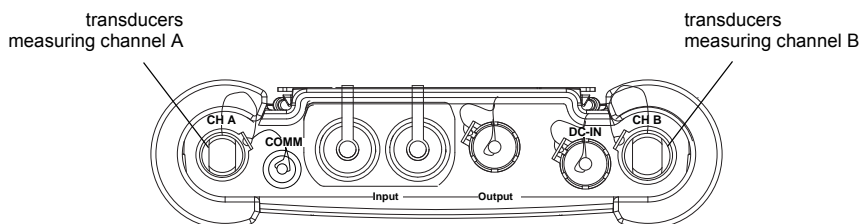
**Fig. 7.4: Transmitter on the pipe**

## 7.3 Connection of the Transducers

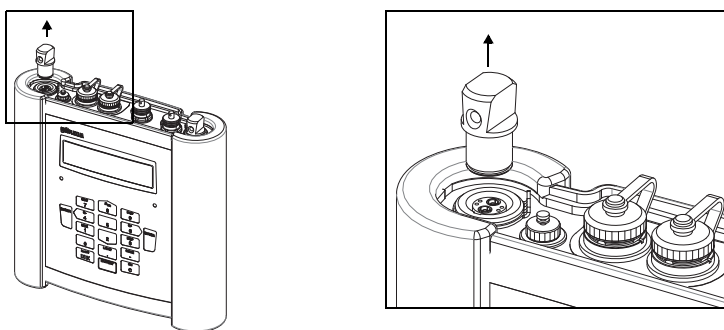
**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

The connections are on the upper side of the transmitter (see Fig. 7.5).

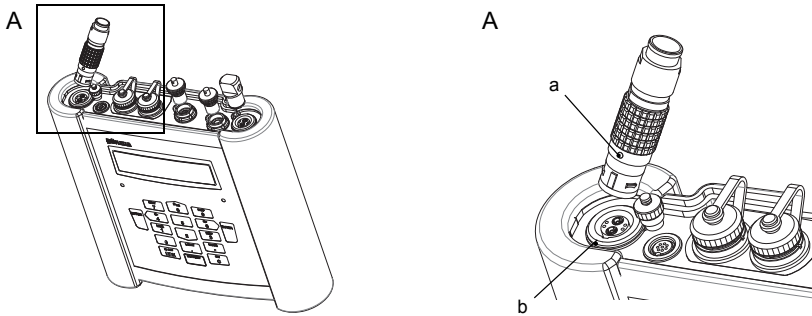
- Remove the blind plug (see Fig. 7.6).
- Insert the connector of the transducer cable in the socket of the transmitter. The red point (a) on the connector must align with the red marking (b) on the socket (see Fig. 7.7).



**Fig. 7.5: Connections of the transmitter FLUXUS G608**



**Fig. 7.6: Removing the blind plug**



**Fig. 7.7: Connection of the transducers**

## 7.4 Power Supply

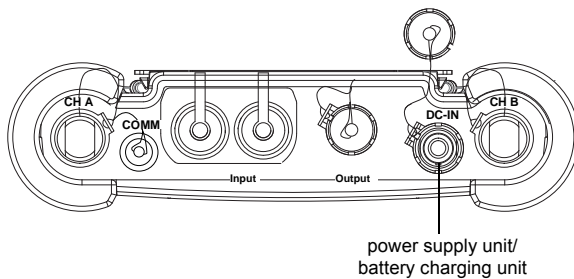
The transmitter can be operated with

- the battery (see section 7.4.1) or
- the power cable and the power adapter (see section 7.4.2).

### 7.4.1 Power Supply with the Battery

**Attention!**

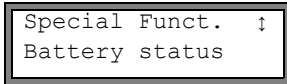
Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).



**Fig. 7.8: Connections of the transmitter FLUXUS G608**

The transmitter has a Li-Ion battery and can be operated independently of the power cable. When delivered, the battery is charged approx. 30 %. The battery does not need to be fully charged before it is used for the first time.

The charge state of the battery can be displayed during the measurement (see section 10.3) and in the program branch Special Funct.:



Select Special Funct.\Battery status. Press ENTER.



The current charge state of the battery is displayed (here: 30 %).

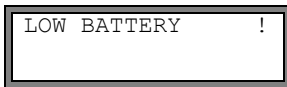
The minus sign "-" indicates that the transmitter is in battery mode and is being discharged.

The number of cycles the battery has passed is displayed after Cy: .

A cycle corresponds to a charging and discharging process. The life time of the battery can be derived by means of this value.

If RELEARN is displayed in the lower line and a question mark "?" is displayed in front of the current charge state, a relearn cycle should be started (see section Maintenance on the following page).

This message will be displayed if the battery is almost empty:



The capacity is sufficient for the display and storing of the current parameter record. A measurement is not possible anymore.

## Charging the Battery

### Attention!

Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

- Connect the power supply unit to the transmitter (see Fig. 7.8).
- Switch on the transmitter.

The charging starts automatically. The LED "BATTERY" flashes green while charging. The max. charging time is approx. 5 h.

During the charging process, the ambient temperature should be in the range 0...60 °C.

A measurement can be made during the charging. Charging will be stopped automatically when the battery is fully charged. The LED "BATTERY" will light green.

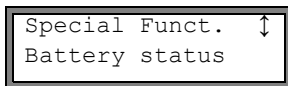
## Storing the Battery

The battery remains in the transmitter. After storage, the transmitter can immediately be operated with the battery.

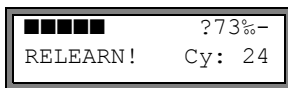
- charge state: > 30 %
- storing temperature: 12...25 °C

## Maintenance (Relearn Cycle)

The accuracy of the displayed value for the charge state of the battery is improved by executing a relearn cycle. The ambient temperature during a relearn cycle should be in the range 12...30 °C.



Select Special Funct.\Battery status. Press ENTER.



The charge state of the battery is displayed (here: 73 %).

The "?" and RELEARN indicate that the displayed charge state is not reliable. A relearn cycle is recommended.

Proceed as follows for a relearn cycle:

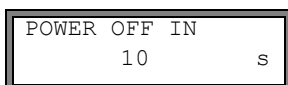
- Charge the battery completely. The LED "BATTERY" lights green when charging is finished.
- Discharge the battery completely: Remove the power supply unit from the transmitter. To deactivate the automatic power off during discharging, start a measurement. Discharging takes min. 14 h. The LED "BATTERY" will flash red afterwards.

After the relearn cycle, the battery can be recharged.

## Automatic Power off

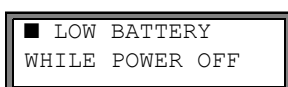
In the battery mode, the transmitter has an automatic power off. The transmitter will be switched off if

- no measurement is being made and no key is pressed in 10 min or
- the battery is empty



This message will be displayed before the transmitter is switched off automatically. A countdown with an acoustic signal will be started.

The countdown can be stopped by pressing any key.



If this message is displayed when the transmitter is switched on, the transmitter has been switched off automatically due to a too low charge state.



- Remove the blind plug (see Fig. 7.9).
- Prepare the cable with an M20 cable gland.
- Push the cable through the cap nut, the compression part and the basic part of the cable gland (see Fig. 7.9).
- Insert the cable into the housing.
- Screw the gasket ring side of the basic part in the housing of the power adapter.
- Fix the cable gland by screwing the cap nut on the basic part of the cable gland.
- Connect the cable to the terminals of the power adapter (see Fig. 7.9 and Tab. 7.1).
- Connect the connector of the power adapter to the socket of the transmitter (see Fig. 7.9).

**Tab. 7.1: Terminal assignment (power adapter)**

terminal	connection DC
(-)	- DC
(+)	+ DC

For the voltage see annex B, section Technical Data.

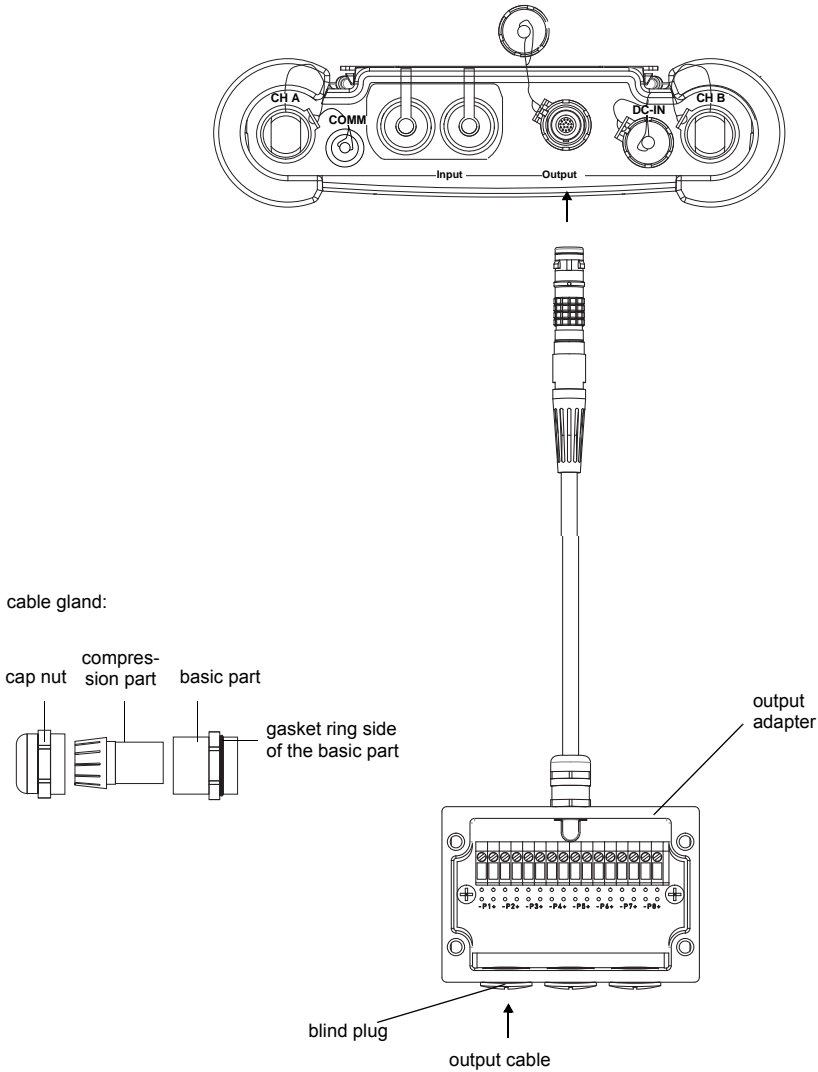
## 7.5 Connection of the Outputs (Optional)

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

The output adapter has to be used for the connection of the output adapters (see Fig. 7.10).

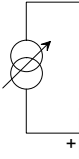
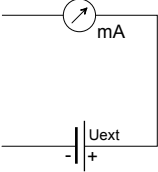

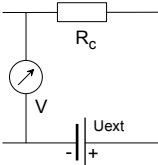
- Remove the blind plug.
- Prepare the output cable with an M20 cable gland.
- Push the output cable through the cap nut, the compression part and the basic part of the cable gland (see Fig. 7.10).
- Insert the output cable in the housing (see Fig. 7.10).
- Screw the gasket ring side of the basic part in the housing of the power adapter.
- Fix the cable gland by screwing the cap nut on the basic part of the cable gland (see Fig. 7.10).
- Connect the leads of the output cable to the terminals of the output adapter (see Fig. 7.10 and Tab. 7.2).

- Remove the socket cover from the transmitter for the connection of the output adapter (see Fig. 7.5).
- Connect the connector of the output adapter to the socket.



**Fig. 7.10: Connection of the output adapter to the transmitter FLUXUS G608**

Tab. 7.2: Circuits of the outputs

output	transmitter internal circuit	connection	external circuit	remark
passive current loop (semi-pas- sive design)		Px+  Px-		$U_{ext} = 4 \dots 9 \text{ V}$ $U_{ext} > 0.021 \text{ A} \cdot R_{ext} [\Omega] + 4 \text{ V}$ example: $U_{ext} = 6 \text{ V}$ $R_{ext} = 0 \dots 90 \Omega$
binary output (op- torelay)		Px+  Px-		$U_{ext} \leq 26 \text{ V}$ $I_c \leq 100 \text{ mA}$

The number, type and connections of the outputs are customized.

$R_{ext}$  is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/volt-meter).

7.6 Connection of the Inputs (Optional)

Attention!

Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

7.6.1 Connection of a Temperature Input

Temperature probes Pt100/Pt1000 (4-wire) can be connected to the inputs of the transmitter (optional) (see Fig. 7.11).

For the assignment and the activation of the temperature inputs see chapter 20.

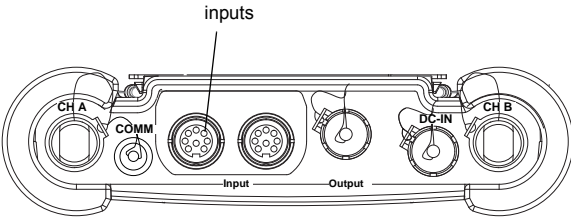
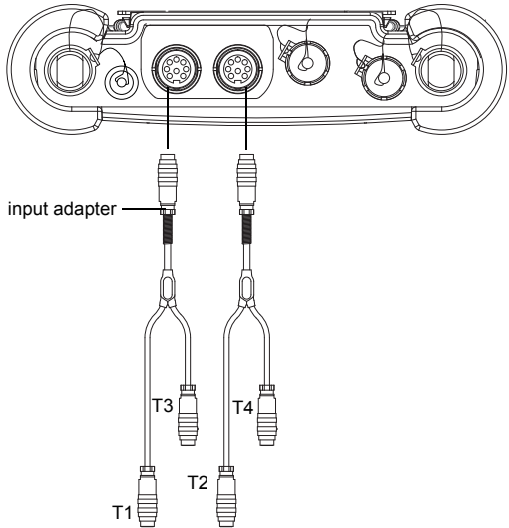


Fig. 7.11: Connection of the transmitter FLUXUS G608

### 7.6.2 Input Adapter (Optional)

The number of temperature inputs can be increased to max. 4 by means of 2 input adapters (see Fig. 7.12).



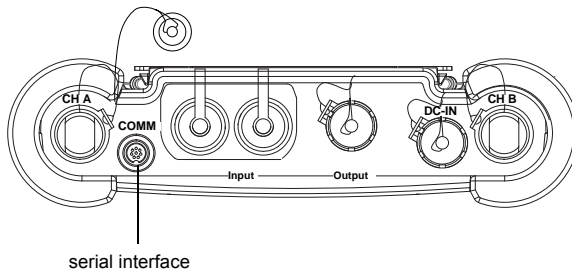
**Fig. 7.12: Connection of the input adapters**

## 7.7 Connection of the Serial Interface

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

- Connect the RS232 cable to the transmitter (see Fig. 7.13) and to the serial interface of the PC. If the RS232 cable can not be connected to the PC, use the RS232/USB adapter.

The RS232 adapter, the RS232 cable and the RS232/USB adapter are part of the serial data kit (optional).



**Fig. 7.13: Connections of the transmitter FLUXUS G608**

## 8 Mounting the Transducers

- Before you start this chapter, read and follow the instruction in chapter 11.

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

The transducers will be fixed to the pipe by means of the supplied transducer mounting fixture.

### 8.1 Preparation of the Pipe Surface

- Mount the damping mats (see section 8.2).
- Use coupling foil (only if damping mats are not installed) or apply a bead of acoustic coupling compound along the center line onto the contact surface of the transducer.
- Observe that there must be no air pockets between the transducer contact surface, damping mat and the pipe wall.
- Make sure that the transducer mounting fixture applies the necessary pressure on the transducers.

### 8.2 Mounting of the Damping Mats

Before the transducers are mounted, damping mats will be installed. The damping mats reduce propagation of acoustic noise in the pipe wall.

- Select the measuring point according to the recommendations in chapter 5.
- Clean the pipe at the selected measuring point:
  - If present, the paint layer must be smoothed by sanding. The paint does not need to be removed completely.
  - Remove rust or loose paint.
  - Remove grease or dust. Clean the pipe surface with soap sud.
- Select the type and the size of the damping mat (see annex B, section Technical Data).
- Select the installation instructions that correspond to the supplied damping mat (see section 8.2.1 or 8.2.2).

### 8.2.1 Mounting of Self-Adhesive Damping Mats

Observe the operating temperature of the damping mat (see annex B, section Technical Data).

**Attention!**

Wear protective gloves and protective goggles when mounting the damping mats.

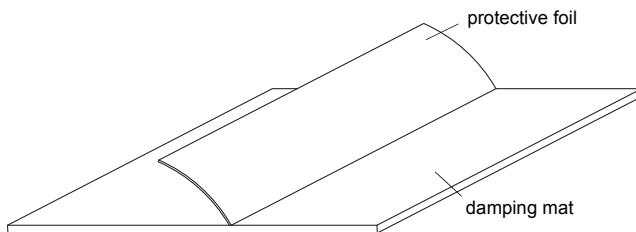
In the event of contact with the eyes:

- rinse immediately with plenty of water and
- see an eye specialist.

In the event of contact with the skin:

- wash the skin immediately with plenty of water.

- Cut the damping mat to size, if necessary (see annex B, section Technical Data).
- Remove a part of the protective foil and fold it (see Fig. 8.1).
- Fix the part of the damping mat without protective foil to the pipe.



**Fig. 8.1: Removal of the protective foil**

- Fix the damping mat to the pipe: remove the protective foil bit by bit from the damping mat and attach the damping mat to the pipe at the same time.

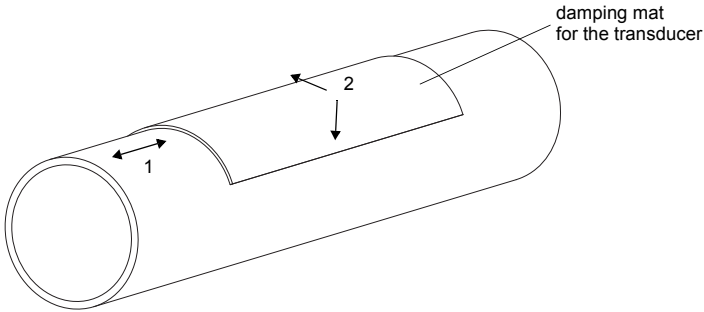
**Note!**

Air pockets have to be avoided.

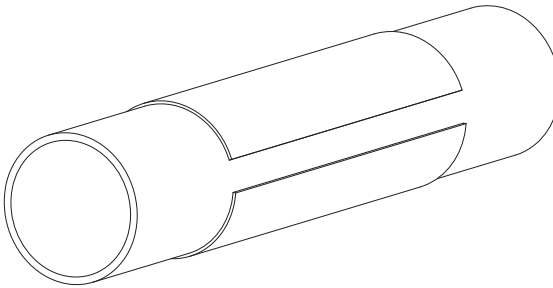
Improvement of adhesion and removal of air pockets:

- Press the roll in the middle of the damping mat along the pipe axis (see 1 in Fig. 8.2).
- Press the roll from the middle to the sides (see 2 in Fig. 8.2).
- Open the remaining air pockets with a knife.

- Repeat the steps for the installation of the damping mat on the opposite side of the pipe in case of a measurement on the diagonal mode (see Fig. 8.3).



**Fig. 8.2: Mounting of the damping mat (reflection mode)**



**Fig. 8.3: Mounting of the damping mat (diagonal mode)**

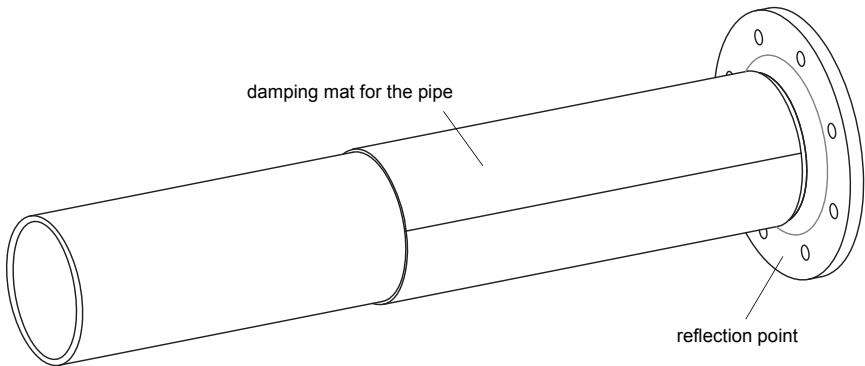
**Note!**

The damping mat adheres strongly to the pipe. Later alignment is not possible. The damping mat has to be positioned correctly immediately.

**Note!**

The damping mat can not be reused after removal.

- Depending on the transducer type, another layer of the damping mat is necessary (see annex B, Technical Data). Repeat the steps for the mounting of the damping mat.
- Mount the transducers onto the damping mat. Select the installation instructions that correspond to the supplied transducer mounting fixture (see section ...).
- If the measuring point is close to a reflection point (e.g. flange), damping mats must be installed there, if necessary (see Fig. 8.4). The damping mats are mounted on the complete circumference of the pipe. Repeat the steps for the installation of the damping mats.



**Fig. 8.4: Mounting of the damping mat at the reflection point**

### 8.2.2 Mounting of non Self-Adhesive Damping Mats

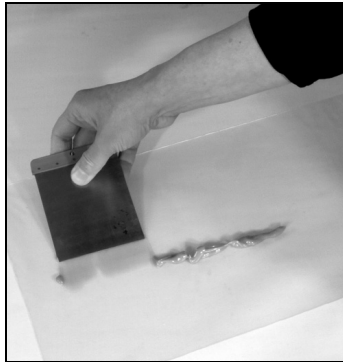
Observe the operating temperature of the damping mat (see annex B, section Technical Data).

The non self-adhesive damping mats can be reused. They are not suitable for permanent use.

A water-based ultrasound gel is used for coupling. The ultrasound gel can dry up and is then no longer effective.

- Cut the damping mat to size, if necessary (see annex B, section Technical Data).
- Apply a bead of the ultrasound gel on the inner side of the damping mat along the center line.
- Spread the ultrasound gel evenly on the surface of the damping mat by means of a spatula (see Fig. 8.5).
- Position the damping mat on the pipe (see Fig. 8.2).
- Remove air pockets by means of the supplied roller.

- Repeat the steps for the installation of the damping mat on the opposite side of the pipe in case of a measurement on the diagonal mode (see Fig. 8.3).



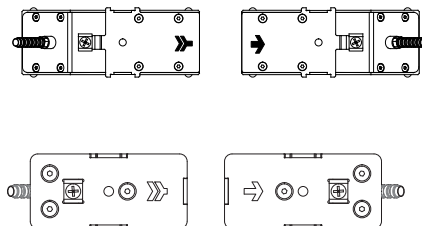
**Fig. 8.5: Application of ultrasound gel to the damping mat**

- Mount the transducers onto the damping mat. Select the installation instructions that correspond to the supplied transducer mounting fixture (see section 8.2.1 or 8.2.2).
- If the measuring point is close to a reflection point (e.g. flange), damping mats must be installed there, if necessary (see Fig. 8.4). The damping mats are mounted on the complete circumference of the pipe. Repeat the steps for the mounting of the damping mats.

### 8.3 Positioning of the Transducers

The transducers are mounted in such way that the engravings on the transducers form an arrow (see ). The transducer cables show in opposite directions.

For the determination of the flow direction with the help of the arrow see section 11.8.



**Fig. 8.6: Korrekte Positionierung der Sensoren**

### 8.3.1 Mounting the Transducers with Portable Variofix Rail with Chains

Normally, each transducer is mounted to its own Variofix rail. If the transducer distance is small and both transducers are on the same side of the pipe (reflection mode), they can be fixed in one Variofix rail.

#### Preparing and fixing the variofix rail

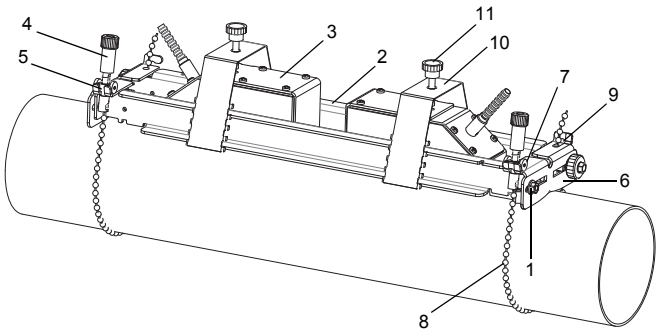
- Adjustment of the Variofix rail to transducer width:
  - Loosen the 4 screws (1) for the adjustment of the rails (2) with a M8 wrench (see Fig. 8.7).
  - Place one transducer (3) in the center between the rails.
  - Press the two rails (2) together and tighten the 4 screws (1). The transducer can be shifted and removed.
  - Remove the transducer.
- Loosen the chain tensioners (4), but do not unscrew them completely.
- If the chain has not yet been mounted to the rail support (6):  
Compress the spring of the chain tensioner (4) with the cylinder (7) while pushing the chain tensioner (4) in the horizontal groove (5) of the rail support (6).
- Place the Variofix rail on the pipe. Both rail supports (6) must be completely supported by the pipe. Lay the ball chain (8) around the pipe (if the pipe is vertical, start with the upper ball chain).
- Press the chain tensioner (4) completely in and push the ball chain (8) in the other groove (9) of the rail support.
- Fix the second ball chain (8) in the same way.
- Tension the ball chains (8) by tightening the chain tensioners (4).
- Repeat the steps if the second transducer is fixed to its own Variofix rail.

#### Fixing the transducer

- Force apart the legs of the spring clip (10) and clamp it over the outer side of the rails (2). The height where the spring clip will snap in depends on the height of the transducer.
- Apply some coupling compound to the contact surface of the transducer.
- Place the transducer between the rails (2). Observe the mounting direction (see Fig. 8.7).
- Push the spring clip (10) over the transducer until the knurled screw (11) is positioned over the blind hole of the transducer.
- Fix the transducer by tightening the knurled screw by hand (11).

- Repeat the steps for fixing the second transducer.
- Adjust the transducer distance by loosening the knurled screw (11) of a spring clip (10) and shifting the transducer.

1	screw	7	cylinder
2	railrail	8	ball chain
3	transducer	9	groove
4	chain tensioner	10	spring clip
5	horizontal groove	11	knurled screw
6	rail support		



**Fig. 8.7: Variofix rail with chains**

## 9 Installation of the Temperature Probe (Optional)

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

### 9.1 Cleaning of the Pipe Surface

- Remove rust, insulation material and loose paint to get a good thermal contact.
- Clean the pipe surface.

Select the installation instructions that correspond to the supplied temperature probe (see section 9.2 or section 9.3).

### 9.2 Installation of the Temperature Probe (Response Time 50 s)

Select the installation instructions that correspond to the supplied clasp:

- for the installation with a clasp see section 9.2.1
- for the installation with a FLEXIM clasp see section 9.2.2
- for the installation with a quick release clasp see section 9.2.3

#### 9.2.1 Installation with a Clasp

- Cut the tension strap to length (pipe circumference + 120 mm).
- Make sure that part (2) of the clasp is on top of part (1) (see Fig. 9.1). The hooks of part (2) must be on the outer side of the clasp.
- Pull approx. 2 cm of the tension strap through the slot of the clasp (see Fig. 9.2) to fix the clasp to the tension strap.
- Bend the end of the tension strap back.

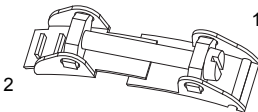


Fig. 9.1: Clasp

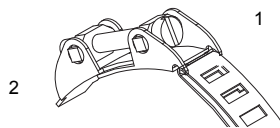


Fig. 9.2: Clasp with tension strap

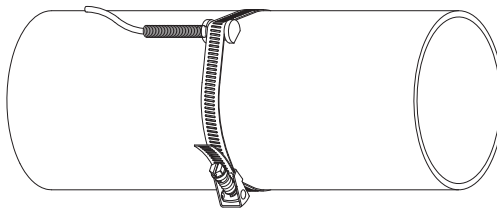


Fig. 9.3: Temperature probe on the pipe

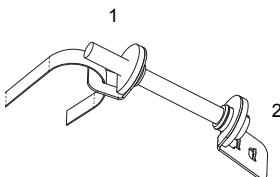
- Position the temperature probe on the pipe (see Fig. 9.3).
- Place the tension strap around the temperature probe and the pipe.
- Insert the tension strap through the parts (2) and (1) of the clasp (see Fig. 9.2).
- Pull the tension strap firmly and engage it in the inner hooks of the clasp.
- Tighten the screws of the clasps.

**Note!**

In case of great temperature differences, it is recommended to thermally insulate the temperature probe from the environment.

### 9.2.2 Installation with a FLEXIM Clasp

- Cut the tension strap to length (pipe circumference + 120 mm).
- Push approx. 2 cm of the tension strap through the slot of the clasp (see Fig. 9.4).
- Bend the end of the tension strap back
- Position the temperature probe on the pipe (see Fig. 9.3).
- Place the tension strap around the temperature probe and the pipe.
- Insert the tension strap through the parts (2) and (1) of the clasp.
- Pull the tension strap firmly and engage it in the inner hooks of the clasp.
- Tighten the screws of the clasp.



**Fig. 9.4: FLEXIM clasp**

**Note!**

In case of great temperature differences, it is recommended to thermally insulate the temperature probe from the environment.

### 9.2.3 Installation With a Quick Release Clasp

- Cut the tension strap to length (pipe circumference + 120 mm).
- Position the temperature probe on the pipe (see Fig. 9.3).
- Place the tension strap around the temperature probe and the pipe.
- Insert the tension strap into the clasp (see Fig. 9.5).
- Tighten the tension strap.
- Tighten the screw of the clasp.

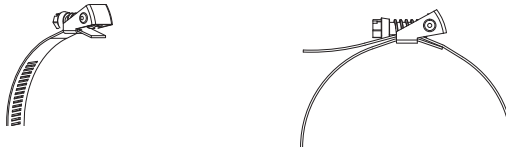


Fig. 9.5: Quick release clasp

**Note!**

In case of great temperature differences, it is recommended to thermally insulate the temperature probe from the environment.

### 9.3 Installation of the Temperature Probe (Response Time 8 s)

- Fix the protection plate and the insulation foam to the temperature probe (see Fig. 9.6).
- Apply a film of thermal conductivity paste (not supplied by FLEXIM) on the contact surface of the temperature probe.

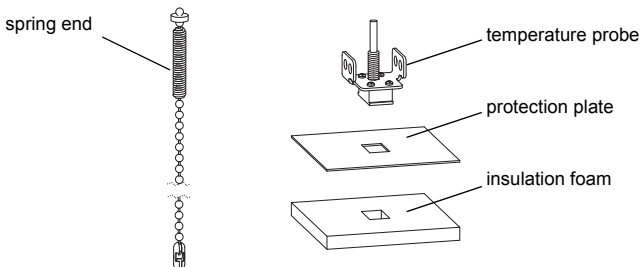


Fig. 9.6: Temperature probe

- Take the spring end of the ball chain and insert the last ball in one of the slots on the upper side of the temperature probe (see Fig. 9.7).
- Place the chain around the pipe. Tighten the chain and insert it in the other slot of the temperature probe.

**Note!** The entire contact surface of the temperature probe must always rest on the pipe. In case of very small piped, the protection plate and the insulation foam must be cut to size, if necessary.

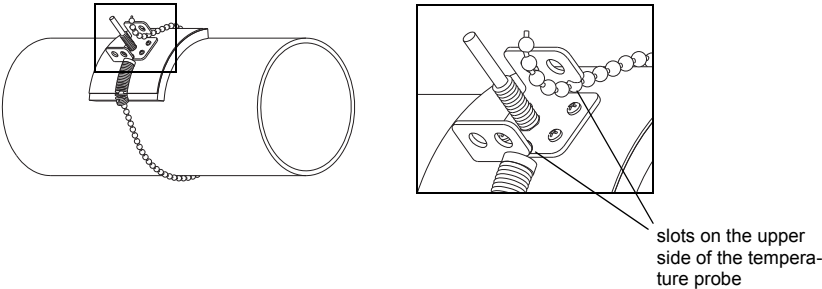


Fig. 9.7: Clasp

## 9.4 Connection of the Temperature Probe

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

Connect the temperature probe to temperature inputs of the transmitter (see Fig. 9.8 or Fig. 9.9 and Tab. 9.1).

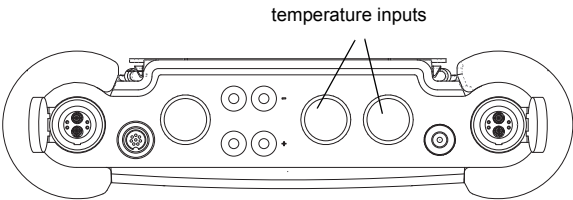


Fig. 9.8: Transmitter FLUXUS G601

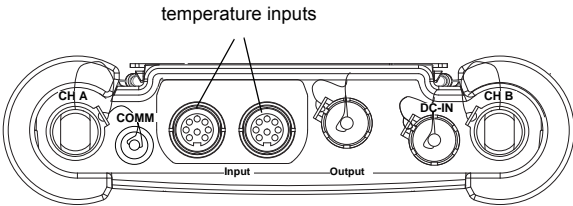


Fig. 9.9: Transmitter FLUXUS G608

Tab. 9.1: Connection of the temperature probe

direct connection	connection via extension cable (optional)
<div> <div>transmitter</div> <div>temperature probe</div> </div> <div> <div>transmitter</div> </div>	<div> <div>transmitter</div> <div>extension cable</div> </div> <div> <div>transmitter</div> <div>temperature probe</div> </div>

For the pin assignment of the temperature probe and the extension cable see Tab. 9.2 and Fig. 9.10.

Tab. 9.2: Pin assignment

terminal	temperature probe	extension cable
1	white/blue	blue
2	red/blue	gray
3,4,5	not connected	not connected
6	red	red
7	white	white
8	not connected	not connected

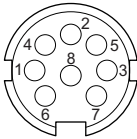


Fig. 9.10: Pins

## 10 Start-up

### 10.1 Switching on/off

```
FLEXIM FLUXUS
G60X-XXXXXXX
```

Press key C to switch on the transmitter.

After the transmitter has been switched on, the display indicates which transducer has been detected at which channel.

Afterwards, the serial number of the transmitter is displayed for a short time.

Data can not be entered while the serial number is displayed.

```
>PAR<mea opt sf
Parameter
```

After the initialization, the main menu is displayed in the selected language. The language of the display can be set (see section 10.4).

Press key BRK three times to switch off the transmitter.

## 10.2 Displays

### 10.2.1 Main Menu

```
>PAR<mea opt sf
Parameter
```

The main menu contains the following program branches:

- par (Parameter)
- mea (Measuring)
- opt (Output Options)
- sf (Special Function)

The selected program branch is displayed in capital letters between arrows. The complete designation of the selected program branch is displayed in the lower line.

Select a program branch by pressing key **4** and **6**. Press ENTER.

**Note!**

By pressing key BRK, the measurement will be stopped and the main menu selected.

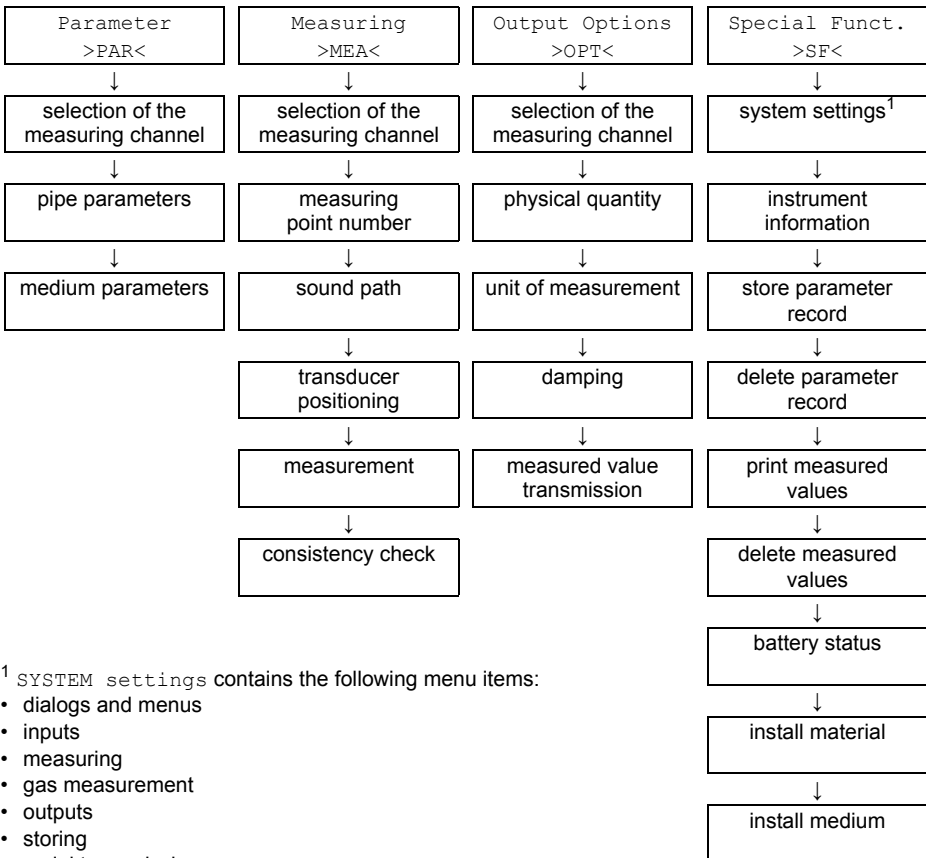
**Note!**

In this user manual, all program entries and keys are indicated with typewriter characters (`Parameter`). The menu items are separated from the main menu by a backslash "\".

## 10.2.2 Overview of the Program Branches

- **Program branch Parameter**  
input of the pipe and medium parameters
- **Program branch Measuring**  
processing of the steps for the measurement
- **Program branch Output Options**  
setting of the physical quantity, the unit of measurement and the parameters for the measured value transmission
- **Program branch Special Funct.**  
contains all functions that are not directly related to the measurement



For an overview of the program branches see figure below. For a detailed overview of the menu structure see annex A.



### 10.2.3 Navigation



A vertical arrow ↑ will be displayed if the menu item contains a scroll list. The current list item will be displayed in the lower line.

```
Parameter      ↑
for Channel    A:
```

Use key  and  to select a list item in the lower line. Press ENTER.



Some menu items contain a horizontal scroll list in the lower line. The selected list item is displayed in capital letters between arrows.



```
Lining
no                >YES<
```

Press key  and  to scroll through the lower line and select a list item. Press ENTER.

Some menu items contain a horizontal scroll list in the upper line. The selected list item is displayed in capital letters between arrows. The current value of the list item is displayed in the lower line.

```
Rl=FUNC<typ mode
Function:      MAX
```

Press key  and  to scroll through the upper line and select a list item.

Press key  and  to scroll through the lower line and select a value for the selected list item.

Press ENTER.

## 10.3 HotCodes

A HotCode is a key sequence used to activate certain settings:

- language selection (see section 10.4)
- activation of the FastFood mode (see section 13.7)
- manual input of the lower limit of the inner pipe diameter (see section 13.9)
- activation the SuperUser mode (see section 18)
- change of the transmission parameters of the RS232 interface (see section 14.2.4)

A HotCode can only be entered in the main menu immediately after the transmitter has been switched on. The HotCode will not be displayed during the input.

## 10.4 Language Selection

The transmitter can be operated in the languages listed below. The language can be selected with the following HotCodes:

**Tab. 10.1: Language HotCodes**

909031	Dutch
909033	French
909034	Spanish
909044	English
909049	German

Depending on the technical data of the transmitter, some of the languages might not be implemented.

When the last digit has been entered, the main menu will be displayed in the selected language.

The selected language remains activated when the transmitter is switched off and on again. After a cold start, the default language set by the manufacturer is activated.

## 11 Basic Measurement

**Attention!** Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS\_608).

The pipe and medium parameters are entered for the selected measuring point (see chapter 5). The parameter ranges are limited by the technical characteristics of the transducers and of the transmitter.

**Note!** During the parameter input, the transducers must be connected to the transmitter.

**Note!** The parameters will only be stored when the program branch `Parameter` has been edited in its entirety.

### 11.1 Input of the Pipe Parameters

```
>PAR<mea opt sf
Parameter
```

Select the program branch `Parameter`. Press ENTER.

```
Parameter      ↑
for Channel    A:
```

Select the channel for which the parameters are to be entered. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

If `Parameter from:` is displayed, at least one parameter record is stored in the transmitter and can be selected. A parameter set contains all data necessary for a measurement:

- pipe parameters
- medium parameters
- transducer parameters
- output options

A parameter record can be defined for each measuring task (see chapter 15).

#### 11.1.1 Outer Pipe Diameter/Pipe Circumference

```
Outer Diameter
100.0      mm
```

Enter the outer pipe diameter. Press ENTER.

```
Outer Diameter
1100.0     MAXIMAL
```

An error message will be displayed if the entered parameter is outside of the range. The limit will be displayed.

example: upper limit 1100 mm for the connected transducers and for a pipe wall thickness of 50 mm.

It is possible to enter the pipe circumference instead of the outer pipe diameter (see section 17.2.1).

If the input of the pipe circumference has been activated and 0 (zero) is entered for the Outer Diameter, the menu item `Pipe Circumfer.` will be displayed. If the pipe circumference is not to be entered, press key `BRK` to return to the main menu and start the parameter input again.

### 11.1.2 Pipe Wall Thickness

Wall Thickness	
3.0	mm

Enter the pipe wall thickness. Press `ENTER`.

<b>Note!</b>	<p>The inner pipe diameter (= outer pipe diameter - 2x pipe wall thickness) is calculated internally. If the value is not within the inner pipe diameter range of the connected transducers, an error message will be displayed.</p> <p>It is possible to change the lower limit of the inner pipe diameter for a given transducer type (see section 13.8).</p>
--------------	---

### 11.1.3 Pipe Material

The pipe material must be selected to be able to determine the sound speed. The sound speed for the materials in the scroll list are stored in the transmitter.

Pipe Material	↓
Carbon Steel	

Select the pipe material.  
If the medium is not in the scroll list, select `Other Material`. Press `ENTER`.

It can be specified which materials will be displayed in the scroll list (see section 16.5).  
When the pipe material has been selected, the corresponding sound speed is set automatically. If `Other Material` has been selected, the sound speed must be entered.

c-Material	
3230.0	m/s

Enter the sound speed of the pipe material. Press `ENTER`.

<b>Note!</b>	Enter the sound speed of the material (i.e. longitudinal or transversal speed) which is nearer to 2500 m/s.
--------------	---

For the sound speed of some materials see annex C.1.

### 11.1.4 Pipe Lining

Lining	
no	>YES<

If the pipe has an inner lining, select `yes`. Press ENTER.

If `no` is selected, the next parameter will be displayed (see section 11.1.5).

Lining	↑
Bitumen	

Select the lining material.

If the material is not in the scroll list, select `Other Material`. Press ENTER.

It can be specified which materials will be displayed in the scroll list (see section 16.5).

If `Other Material` is selected, the sound speed must be entered.

c-Material	
3200.0	m/s

Enter the sound speed of the lining material. Press ENTER.

For the sound speed of some materials see annex C.1.

Liner Thickness	
3.0	mm

Enter the thickness of the liner. Press ENTER.

#### Note!

The inner pipe diameter (= outer pipe diameter - 2x pipe wall thickness - 2x liner thickness) is calculated internally. If the value is not within the inner pipe diameter range of the connected transducers, an error message will be displayed.

It is possible to change the lower limit of the inner pipe diameter for a given transducer type (see section 13.8).

### 11.1.5 Pipe Roughness

The flow profile of the medium is influenced by the roughness of the inner pipe wall. The roughness will be used for the calculation of the profile correction factor. As, in most cases, the pipe roughness can not be exactly determined, it has to be estimated.

For the roughness of some materials see annex C.2.

Roughness	
0.4	mm

Enter the roughness of the selected pipe or liner material.

Change the value according to the condition of the inner pipe wall. Press ENTER.

## 11.2 Input of the Medium Parameters

Medium  
Natural gas user

Select the medium from the scroll list.

If the medium is not in the scroll list, select Other Medium. Press ENTER.

It is possible to specify which media will be displayed in the scroll list (see section 16.5).

For the programmed parameters of common media see annex C.3.

If a medium is selected from the scroll list, the menu item for the input of the medium temperature is displayed directly (see section 11.2.5).

If **Other Material** is selected or no data set for the selected medium is stored in the transmitter (e.g. natural gas, as the parameters depend on the composition of the natural gas), the medium parameters must be entered first.

- min. and max. sound speed
- kinematic viscosity
- density
- gas compressibility factor

### 11.2.1 Sound Speed

The sound speed of the medium is used for the calculation of the transducer distance at the beginning of the measurement. However, the sound speed does not affect the measuring result directly. Often, the exact value of the sound speed for a medium is unknown. Therefore, a range of possible values for the sound speed must be entered.

c-Medium	1500.0	m/s
----------	--------	-----

Enter the average sound speed of the medium. Press ENTER.

This display will only be indicated if Other Medium has been selected.

```
c-Medium range
auto          >USER<
```

Select auto or user. Press ENTER.

**auto:** The area around the average sound speed is defined by the transmitter.

user: The area around the average sound speed must be entered.

c-Medium=1500m/s  
range      +-150m/s

Enter the area around the average sound speed of the medium. Press ENTER.

This display will only be indicated if `user` has been selected.

### 11.2.2 Kinematic Viscosity

The kinematic viscosity affects the flow profile of the medium. The entered value and other parameters are used for the profile correction.

Kinem.Viscosity
1.00      mm <sup>2</sup> /s

Enter the kinematic viscosity of the medium. Press ENTER.

This display will only be indicated if **Other Medium** has been selected or no data set for the selected medium is stored in the transmitter (e.g. natural gas).

### 11.2.3 Density

The density is used to calculate the mass flow rate (product of the volumetric flow rate and the density).

Density
60.00      kg/m <sup>3</sup>

Enter the operating density of the medium. Press ENTER.

This display will only be indicated if **Other Medium** has been selected or no data set for the selected medium is stored in the transmitter (e.g. natural gas).

### 11.2.4 Gas Compressibility Factor

The gas compressibility factor is necessary for the calculation of the standard volumetric flow rate (see section 12.1.1). Note that the value is selected correspondingly to the operating pressure, the operating temperature and the composition of the gas.

Gas compr.factor
1.000      factor

Enter the gas compressibility factor. Press ENTER.

This display will only be indicated if **Other Medium** has been selected or no data set for the selected medium is stored in the transmitter (e.g. natural gas).

### 11.2.5 Medium Temperature

The medium temperature is used for the interpolation of the sound speed and for the calculation of the recommended transducer distance and for the interpolation of the gas compressibility factor at the beginning of the measurement.

During the measurement, the medium temperature is used for the interpolation of the density and the viscosity of the medium.

The value entered here will be used for the calculations if the medium temperature is not measured and fed to an input of the transmitter.

Medium Temperat.
20.0      °C

Enter the medium temperature. The value must be within the operating temperature range of the transducers. Press ENTER.

## 11.2.6 Medium Pressure

The medium pressure is used for the interpolation of the sound speed and of the gas compressibility factor.

```
Fluid pressure
  60.00      bar
```

Enter the medium pressure. Press ENTER.

This display will only be indicated if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is activated OR if Gas-Measuring is deactivated and Special Funct.\SYSTEM settings\Dialogs/Menus/Fluid pressure is activated.

## 11.3 Other Parameters

### 11.3.1 Transducer Parameters

If transducers are detected on a measuring channel, the parameter input finished. Press ENTER. The main menu will be displayed.

If no or special transducers are connected, the transducer parameters have to be entered.

```
Transducer Type ↑
Standard
```

Select **Standard** to use the standard transducer parameters stored in the transmitter.

Select **Special Version** to enter the transducer parameters. The transducer parameters must be provided by the transducer manufacturer.

Press ENTER.

#### Note!

If standard transducer parameters are used, FLEXIM can not guarantee for the precision of the measured values. A measurement might even be impossible.

```
Transd. Data      1
  35.99
```

If **Special Version** has been selected, enter the 6 transducer parameters specified by the manufacturer. Press ENTER after each input.

## 11.4 Selection of the Channels

The channels on which will be measured can be activated individually.

```
par>MEA<opt sf
Measuring
```

Select program branch **Measuring**. Press ENTER.

```
par>MEA<opt sf
NO DATA!
```

If this error message is displayed, the parameters are not complete. Enter the missing parameters in the program branch **Parameter**.

```
CHANN: >A< B Y Z
MEASUR  ✓  ✓  -  .
```




The channels for the measurement can be activated and deactivated.

- ✓: the channel is active
- : the channel is not active
- : the channel can not be activated

This display will not be indicated if the transmitter has only one measuring channel.

**Note!**

A channel can not be activated if the parameters are not valid, e.g. if the parameters in the program branch `Parameter` of the channel are not complete.

- Select a channel with key  and .
- Press key  to activate or deactivate the selected channel. Press ENTER.

A deactivated channel will be ignored during the measurement. Its parameters will remain unchanged.

If the data logger or the serial interface is activated, the measuring point number must be entered:

## 11.5 Defining the Number of Sound Paths

The number of transits of the ultrasonic waves through the medium depends on the placement of the transducers on the pipe.

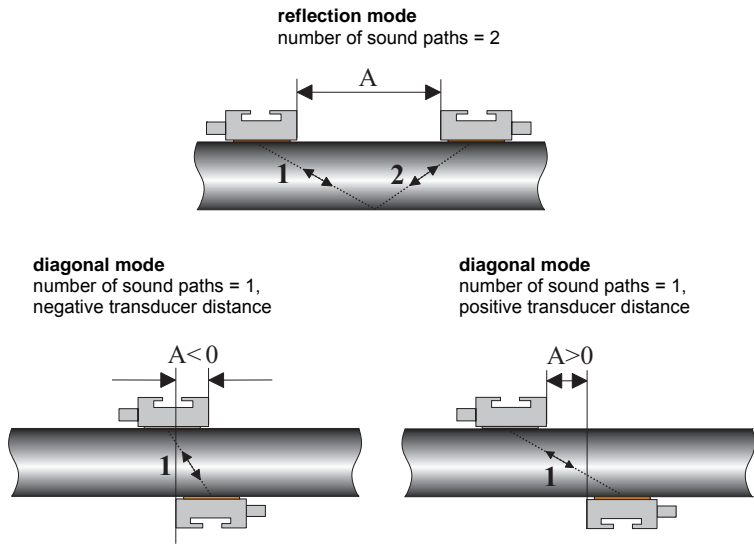
If the number of transits is odd (diagonal mode), the transducers will be mounted on opposite sides of the pipe.

If the number of transits is even (reflection mode), the transducers will be mounted on the same side of the pipe.

```
A:Meas.Point No.:
xxx (↑↓←→)
```

Enter the measuring point number. Press ENTER.

If arrows are displayed in the lower line on the right, ASCII text can be entered. If no arrows are displayed, only digits, point and hyphen can be entered.



**Fig. 11.1: Sound path and transducer distance (A)**

A higher number of transits means increased accuracy of the measurement. However, the increased transit distance results in a higher attenuation of the signal.

The reflections on the opposite pipe wall and deposits on the inner pipe wall cause additional amplitude losses of the sound signal.

If the signal is attenuated strongly, e.g. by the medium, the pipe, deposits, etc., the number of sound paths must be set to 1 if necessary.

**Note!**

Exact positioning of the transducers is easier for an even number of transit paths (reflection mode) than for an odd number (diagonal mode).

A: Sound Path

2NUM

A value for the number of sound paths corresponding to the connected transducers and the entered parameters will be recommended. Change the value if necessary. Press ENTER.

## 11.6 Transducer Distance

Transd. Distance  
A:54 mm Reflec

A value for the transducer distance is recommended. Fix the transducers (see chapter 8). Adjust the transducer distance.

Press ENTER.

A - measuring channel

Reflec - reflection mode

Diagon - diagonal mode

The transducer distance displayed here is the distance between the inner edges of the transducers

In case of a measurement in diagonal mode on very small pipes, a negative transducer distance is possible (see Fig. 11.1).

**Note!**

The accuracy of the recommended transducer distance depends on the accuracy of the entered pipe and medium parameters.

### 11.6.1 Fine Adjustment of the Transducer Distance

Transd. Distance  
A: 54 mm !

If the displayed transducer distance is adjusted, press ENTER.

The measuring for the positioning of the transducers is started.


S=■■■■■■■■  
A: ■<>■=54 mm!

The amplitude of the received signal is displayed by the bar graph S=.

If the LED of the measuring channel lights green, the signal is sufficient for a measurement.

If the LED of the measuring channel lights red, the signal is not sufficient for a measurement.

- Shift a transducer slightly in the range of the recommended transducer distance until the LED of the measuring channel lights green.



The following can be displayed in the upper line with key **9** and in the lower line with key **3**:

- transducer distance
- C (SNR - signal-to-noise ratio)

If min. one box is displayed, the signal is sufficient for the measurement. Three or more boxes are optimal for a measurement.

- bar graph  $Q$ = (signal quality), must have max. length
- transit time  $t_{\text{time}}$  in  $\mu\text{s}$
- bar graph  $S$ = (signal amplitude)

If the signal is not sufficient for measurement, Q= UNDEF will be displayed.

In case of large deviations, check if the entered parameters are correct or repeat the measurement at a different point on the pipe.

Transd. Distance?  
53.9 mm

After the precise positioning of the transducers, the recommended transducer distance is displayed again.

Enter the actual (precise) transducer distance. Press ENTER.

Repeat the steps for all channels on which will be measured. The measurement will be started automatically afterwards.

### 11.6.2 Consistency Check

If a wide range for the sound speed has been entered in the program branch **Parameter** or the exact parameters of the medium are not known, a consistency check is recommended.

The transducer distance can be displayed during measurement by scrolling with key **9**.

L=(50.0) 54.0 mm  
54.5 m3/h

The optimum transducer distance (here: 50.0 mm) is displayed in the upper line in parentheses, followed by the entered transducer distance (here: 54.0 mm). The latter value must correspond to the adjusted transducer distance. Press ENTER to optimize the transducer distance.

The optimum transducer distance is calculated on the basis of the measured sound speed. It is therefore a better approximation than the first recommended value which had been calculated on the basis of the sound speed range entered in the program branch **Parameter**.

If the difference between the optimum and the entered transducer distance is less than specified in Tab. 11.1, the measurement is consistent and the measured values are valid. The measurement can be continued.

If the difference is greater, adjust the transducer distance to the displayed optimum value. Afterwards, check the signal quality and the signal amplitude bar graph (see section 11.6.1). Press ENTER.

**Tab. 11.1: Standard values for signal optimization**

transducer frequency (third character of the technical type)	Difference between the optimum and the entered transducer distance [mm]	
	shear wave transducer	lamb wave transducer
G	20	-50...+100
H	-	-35...+60
K	15	-25...+40
M	10	-10...+20
P	8	-6...+10
Q	6	-3...+5
S	3	-

Transd. Distance?  
50.0 mm

Enter the new adjusted transducer distance. Press ENTER.

L=(51.1) 50.0 mm  
54.5 m3/h

Scroll with key **9** again until the transducer distance is displayed and check the difference between the optimum and the entered transducer distance. Repeat the steps if necessary.

**Note!**

If the transducer distance is changed during the measurement, the consistency check will have to be repeated.

Repeat the steps for all channels on which a measurement is being made.

### 11.6.3 Value of the Sound Speed

The sound speed of the medium can be displayed during the measurement by pressing key **3**.

If an approximate range for the sound speed has been entered in the program branch `Parameter` and the transducer distance has been optimized afterwards as described in section 11.6.2, it is recommended to write down the sound speed for the next measurement. By doing this, it will not be necessary to repeat the fine adjustment.

Also write down the medium temperature because the sound speed depends on the temperature. The value can be entered in the program branch `Parameter` or a user defined medium can be created for this sound speed (see section 16.2 and 16.3).

## 11.7 Start of the Measurement

```
A:act. Volume flow
    31.82      m3/h
```

The measured values are displayed in the lower line. Press ENTER to return to the fine adjustment of the transducer distance (see section 11.6.1).

If the standard volumetric flow rate is selected as the physical quantity during the gas measurement, the operating volumetric flow rate can also be displayed.

```
A:Norm. volume
flow
```

Press key **9** to display the operating volumetric flow rate.

The character \* indicates that the displayed value (here: operating volumetric flow rate) is not the selected physical quantity (here: standard volumetric flow rate).

```
A:act. Volume flow
*   31.82      m3/h
```

If more than one measuring channel is available/activated, the transmitter works with an integrated measuring point multiplexer providing simultaneous measurement on the different measuring channels.

The flow is measured on one measuring channel for approx. 1 s, then the multiplexer switches to the next activated channel.

The time necessary for the measurement depends on the measuring conditions. E.g. if the measuring signal can not be detected immediately, the measurement time might be > 1 s.

The outputs and the serial interface continuously receive the measured values of the corresponding channel. The results are displayed according to the currently selected output options. The default unit of measurement of the volumetric flow rate is m<sup>3</sup>/h. For the selection of the values to be displayed and for the setting of the output options see chapter 12. For further measuring functions see chapter 13.

## 11.8 Detection of the Flow Direction

The flow direction in the pipe can be detected with the help of the displayed volumetric flow rate in conjunction with the arrow on the transducers:

- The medium flows in the direction of the arrow if the displayed volumetric flow rate is positive (e.g.  $54.5 \text{ m}^3/\text{h}$ ).
- The medium flows against the direction of the arrow if the displayed volumetric flow rate is negative (e.g.  $-54.5 \text{ m}^3/\text{h}$ ).

## 11.9 Stopping the Measurement

The measurement will be interrupted by pressing key BRK.

<b>Note!</b>	Be careful not to stop a current measurement by inadvertently pressing key BRK!
--------------	---

## 12 Displaying the Measured Values

The physical quantity is set in the program branch `Output Options` (see section 12.1). During the measurement, the designation of the physical quantity is displayed in the upper line, the measured value in the lower line. The display can be adapted (see section 12.3).

### 12.1 Selection of the Physical Quantity and of the Unit of Measurement

The following physical quantities can be measured:

- **sound speed**
- **flow velocity**: is calculated on the basis of the measured transit time difference
- **operating volumetric flow rate**: is calculated by multiplying the flow velocity by the cross-section of the pipe
- **standard volumetric flow rate**: is calculated on the basis of the operating volumetric flow rate (see section 12.1.1)
- **mass flow rate**: is calculated by multiplying the volumetric flow rate by the operating density of the medium

The physical quantity is selected as follows:

```
par mea >OPT< sf
Output Options
```

Select the program branch `Output Options`. Press ENTER.

```
Output Options ↑
for Channel A:
```

Select the channel for which the physical quantity is to be entered. Press ENTER.

This display will not be indicated, if the transmitter has only one measuring channel.

```
Physic. Quant. ↓
act. Volume flow
```

Select the physical quantity in the scroll list. Press ENTER.

```
Volume in: ↑
m3/h
```

For the selected physical quantity (except for the sound speed), a scroll list with the available units of measurement is displayed. The previously selected unit of measurement is displayed first.

Select the unit of measurement of the selected physical quantity. Press ENTER.

Press BRK to return to the main menu. The further menu items of the program branch `Output Options` are for the activation of the measured value transmission.

#### Note!

If the physical quantity or the unit of measurement is changed, the settings of the outputs will have to be checked (see chapter 21).

### 12.1.1 Measurement of the Standard Volumetric Flow Rate

If the medium is a gas, the standard volumetric flow rate can be selected as the physical quantity in addition to the operating volumetric flow rate. The standard volumetric flow rate is calculated as follows:

$$V_N = V \cdot p/p_N \cdot T_N/T \cdot 1/K$$

$V_N$  - standard volumetric flow rate

$V$  - operating volumetric flow rate

$p_N$  - standard pressure (absolute value)

$p$  - operating pressure (absolute value)

$T_N$  - standard temperature in K

$T$  - operating temperature in K

$K$  - gas compressibility factor

Standard pressure  $p_N$  and standard temperature  $T_N$  are set in `Special Funct.\SYS-TEM settings\Gas-Measuring\Normal pressure` and `Normal temper..`

If the operating pressure  $p$  and the operating temperature  $T$  are measured and fed to the transmitter, they will be used for the calculation of the standard volumetric flow rate. Otherwise, they will be set in `Parameter\Fluid pressure` and `Medium Temperat..`

The gas compressibility factor  $K$  is stored in the medium data set. If `Other Medium` is selected or if there is no data set for the selected medium, the compressibility factor will be set in `Parameter\Gas compr.factor`. Note that the value is to be selected correspondingly to the operating pressure, the operating temperature and the composition of the gas.

## 12.2 Toggling Between the Channels

If more than one channel is available/activated, the display for the measured values can be adapted as follows:

- AutoMux mode
  - all channels
  - only calculation channels
- HumanMux mode

Key  toggles between the modes.

### 12.2.1 AutoMux Mode

In the AutoMux mode, the display and the measuring process are synchronized. The channel on which a measurement is being made is displayed in the upper line on the left.

The measured values are displayed as configured in the program branch `Output Options` (see section 12.1). When the multiplexer switches to the next channel, the display is updated.

A:act. Volume flow	
54.5	m3/h

B:Flow Velocity	
1.25	m/s

The AutoMux mode is the default display mode. It is activated after a cold start.

## All Channels

The measured values of all channels (measuring and calculation channels) are displayed. The next active channel is displayed after min. 1.5 s.

## Only Calculation Channels

Only the measured values of the calculation channels are displayed. The next active calculation channel is displayed after min. 1.5 s.

This mode can only be activated if at least 2 calculation channels are active.

### 12.2.2 HumanMux Mode

In the HumanMux mode, the measured values of one channel are displayed. The measurement on the other channels is continued, but not displayed.



The selected channel is displayed left in the upper line.

Press key **7** <sup>NEXT</sup> to display the next activated channel. The measured values of the selected channel will be displayed as configured in the program branch *Output Options* (see section 12.1).

## 12.3 Adjustment of the Display

During the measurement, the display can be adapted as to display two measured values simultaneously (one in each line of the display). This does not affect totalizing, storing of measured values, measured value transmission, etc.

The following information can be displayed in the upper line:

- designation of the physical quantity
- totalizer values, if activated
- temperatures assigned to the channel and their difference if the temperature is measured
- date and time at which the data logger will be full
- measuring mode
- transducer distance
- alarm state indication if it is activated (see section 21.7.5) and if alarm outputs are activated (see section 21.6).
- charge state of the battery

The following information can be displayed in the lower line:

- flow velocity
- sound speed
- mass flow rate
- volumetric flow rate

Press key **9** <sup>UP</sup> during the measurement to change the display in the upper line, press key **3** <sup>DOWN</sup> to change the display in the lower line.


```
A:Flow Velocity
* 2.47 m/s
```

The character \* indicates that the displayed value (here: flow velocity) is not the selected physical quantity.

## 12.4 Status Line

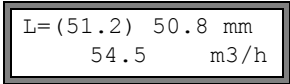
Important data on the ongoing measurement are displayed in the status line. The quality and precision of the ongoing measurement can be estimated.


```
A: S3 Q9 c✓ RT F↓
```

Press key  during the measurement to scroll through the upper line to the status line.

	value	explanation
S	0	<b>signal amplitude</b> < 5 %
	...	...
	9	≥ 90 % Values ≥3 are sufficient for the measurement.
Q	0	<b>signal quality</b> < 5 %
	...	...
	9	≥ 90 %
c		<b>sound speed</b> comparison of the measured and the expected sound speed of the medium. The expected sound speed is calculated on the basis of the medium parameters (medium selected in the program branch <i>Parameter</i> , temperature dependency, pressure dependency).
	√	ok, is equal to the expected value
	↑	> 20 % of the expected value
	↓	< 20 % of the expected value
	?	unknown, can not be measured
R		<b>flow profile</b> information about the flow profile based on the Reynolds number
	T	fully turbulent flow profile
	L	fully laminar flow profile
	↕	the flow is in the transition range between laminar and turbulent flow
	?	unknown, can not be calculated
F		<b>flow velocity</b> comparison of the measured flow velocity with the flow limits of the system
	√	ok, the flow velocity is not in the critical range
	↑	the flow velocity is higher than the current limit
	↓	the flow velocity is lower than the current cut-off flow (even if it is not set to zero)
	0	the flow velocity is in the offset range of the measuring method
	?	unknown, can not be measured

# 12.5 Transducer Distance



By pressing key  during the measurement, it is possible to scroll to the display of the transducer distance.

The optimum transducer distance (here: 51.2 mm) is displayed in parentheses in the upper line, followed by the entered transducer distance (here: 50.8 mm).  
 The optimum transducer distance might change during the measurement (e.g. due to temperature fluctuations).  
 A deviation from the optimum transducer distance (here: -0.4 mm) is compensated internally.

<p><b>Note!</b>                      Never change the transducer distance during the measurement!</p>
---

## 13 Advanced Measuring Functions

### 13.1 Damping Factor

Each displayed measured value is a floating average of all measured values of the last x seconds, with x being the damping factor. A damping factor of 1 s means that the measured values are not averaged because the measuring rate is approx 1/s. The default value of 10 s is appropriate for normal flow conditions.

Strongly fluctuating values caused by high flow dynamics require a higher damping factor.

Select the program branch `Output Options`. Press ENTER until the menu item `Damping` is displayed.

Damping
10 s

Enter the damping factor. Press ENTER.

Press BRK to return to the main menu.

### 13.2 Totalizers


Total volume or total mass of the medium at the measuring point can be determined.

There are two totalizers, one for the positive flow direction, one for the negative flow direction.

The unit of measurement used for totalizing corresponds to the volume or mass unit selected for the physical quantity.

The value of a totalizer consists of max. 11 digits, including max. 4 decimal places. For the adjustment of the number of decimal places see section 18.6.






A:act. Volume flow
54.5 m3/h

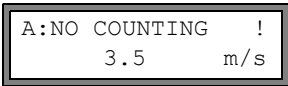
To activate the totalizers, press key  during the measurement (see Tab. 13.1).

A: 32.5 m3
54.5 m3/h

The value of the totalizer will be displayed in the upper line (here: the volume which has passed through the pipe at the measuring point in the positive flow direction after the activation of the totalizers).

Tab. 13.1: Keys for display of the totalizers

activation	press key  once during the measurement
deactivation	press key  three times during the measurement
display of the totalizer for the positive flow direction	press key  during the measurement
display of the totalizer for the negative flow direction	press key  during the measurement
reset of the totalizers to zero	press key  three times during measurement



This error message will be displayed if the totalizers of a measuring channel used for measuring the flow velocity are to be activated. The flow velocity can not be totalized.

**Note!** The totalizers can only be activated for the measuring channel whose measured values are displayed at the moment.

**Note!** The pressing of a key will only influence the totalizers if the totalizer is displayed in the upper line.

Selection of the Totalizers for Storing

It is possible to store only the value of the totalizer that is currently displayed or one value for each flow direction. Select Special Funct.\SYSTEM settings\Storing\Quantity Storage.



If **one** is selected, only the value of the totalizer that is currently displayed will be stored.

If **both** is selected, the values of the totalizers totalizer for both flow directions will be stored.

Press ENTER.

When the Measurement is Stopped

The behavior of the totalizers when the measurement is stopped or after a RESET of the transmitter is set in Special Funct.\SYSTEM settings\Measuring\Quantity recall.



If **on** is selected, the values of the totalizers will be stored and used for the next measurement.

If **off** is selected, the totalizers will be reset to zero.

### 13.2.1 Overflow of the Totalizers

The overflow behavior of the totalizers can be set:

#### Without Overflow:

- The value of the totalizer increases to the internal limit of  $10^{38}$ .
- if necessary, the values will be displayed as exponential numbers ( $\pm 1.00000E10$ ). The totalizer can only be reset to zero manually.

#### With Overflow:

- The totalizer will be reset to zero automatically when  $\pm 9999999999$  is reached.

Select `Special Funct.\SYSTEM settings\Measuring\Quant. wrapping`.

Quant. wrapping  
off >ON<

Select `on` to work with overflow. Select `off` to work without overflow. Press ENTER.

Independently of the setting, the totalizers can be reset to zero manually.

#### Note!

The overflow of a totalizer influences all output channels, e.g. data logger, online transmission of data.

The transmission of the sum of both totalizers (the throughput  $\Sigma Q$ ) via an output will not be valid after the first overflow (wrapping) of one of the corresponding totalizers.

To signalize the overflow of a totalizer, an alarm output with the switching condition `QUANT.` and the type `HOLD` must be activated.

## 13.3 Upper Limit of the Flow Velocity

Single outliers caused by heavily disturbed surroundings can appear among the measured values of the flow velocity. If the outliers are not ignored, they will affect all derived physical quantities, which will then be unsuitable for the integration (e.g. pulse outputs).

It is possible to ignore all measured flow velocities higher than a upper limit. These measured values will be marked as outliers.

The upper limit of the flow velocity is set in `Special Funct.\SYSTEM settings\Measuring\Velocity limit`.

```
Velocity limit
0.0      m/s
```

Enter 0 (zero) to switch off the checking for outliers.

Enter a limit > 0 to switch on the checking for outliers. The measured flow velocity will then be compared to the entered upper limit.

Press ENTER.

If the flow velocity is higher than the upper limit,

- the flow velocity will be marked as invalid. The physical quantity can not be determined.
- the LED of the measuring channel will light red
- "!" will be displayed after the unit of measurement (in case of a normal error, "?" is displayed)

**Note!**

If the upper limit is too low, a measurement might be impossible because most of the measured values will be marked as "invalid".

### 13.4 Cut-off Flow

The cut-off flow is a lower limit for the flow velocity. All measured flow velocities that are lower than the limit and their derived values are set to zero.

The cut-off flow can depend on the flow direction or not. The cut-off flow is set in Special Funct.\SYSTEM settings\Measuring\Cut-off Flow.

```
Cut-off Flow
absolut    >SIGN<
```

Select `sign` to define a cut-off flow in dependence on the flow direction. Two independent limits are set for the positive and negative flow directions.

Select `absolut` to define a cut-off flow independently of the flow direction. A limit is set for the absolute value of the flow velocity.

Press ENTER.

```
Cut-off Flow
factory    >USER<
```

Select `factory` to use the default limit of 2.5 cm/s (0.025 m/s) for the cut-off flow.

Select `user` to enter the cut-off flow.

Press ENTER.

If `Cut-off Flow\sign` and `user` are selected, two values will have to be entered:

```
+Cut-off Flow
   2.5      cm/s
```

Enter the cut-off flow. Press ENTER.

All positive values of the flow velocity that are lower than this limit will be set to zero.

```
-Cut-off Flow
  -2.5      cm/s
```

Enter the cut-off flow. Press ENTER.

All negative values of the flow velocity greater than this limit will be set to zero.

If `Cut-off Flow\absolut` and `user` is selected, only one value will have to be entered:

```
Cut-off Flow
   2.5      cm/s
```

Enter the cut-off flow. Press ENTER.

The absolute values of all flow velocity values that are lower than this limit will be set to zero.

### 13.5 Uncorrected Flow Velocity

For special applications, the uncorrected flow velocity might be of interest.

The profile correction for the flow velocity is activated in `Special Funct.\SYSTEM settings\Measuring\Flow Velocity`.

```
Flow Velocity
>NORMAL< uncorr.
```

Select `normal` to display and transmit the flow velocity with profile correction.

Select `uncorr.` to display the flow velocity without profile correction. Press ENTER.

```
A:PROFILE CORR.
>NO<          yes
```

If `uncorr.` is selected, it has to be confirmed each time the program branch `Measuring` is selected if the profile correction is to be used.

```
A:FLOW VELOCITY
   2.60      m/s
```

If `no` is selected, the profile correction will be switched off.

All physical quantities will be calculated with the uncorrected flow velocity.

During the measurement, the designation of the physical quantity will be displayed in capital letters to indicate that the value is uncorrected.

Press ENTER.

```
A:PROFILE CORR.
NO                >YES<
```

If `yes` is selected, the uncorrected flow velocity will only be used if the flow velocity is selected as the physical quantity in the program branch `Output Options`.


All other physical quantities (volumetric flow rate, mass flow, rate etc.) will be determined with the corrected flow velocity.

During the measurement, the designation of the physical quantity will be displayed in capital letters to indicate that the value is uncorrected.

Press ENTER.

```
A:Flow Velocity
*U  54.5      m/s
```

In both cases, the corrected flow velocity can also be displayed.

Scroll with key  until the flow velocity is displayed. The uncorrected flow velocity is marked with `U`.

Uncorrected flow velocities transmitted to a PC are marked with `uncorr.`

## 13.6 Measurement of Highly Dynamic Flows (FastFood Mode)

The FastFood mode enables the measurement of flows with high dynamics.

A continuous adaptation to changing measuring conditions which takes place in the normal measuring mode is only partially realized in the FastFood mode.

- The sound speed of the medium is not measured. Instead, the sound speed stored in the internal database is used, taking into account the medium temperature entered in the program branch `Parameter` (or the measured temperature if the medium temperature is measured).
- A change of measuring channel is not possible.
- The inputs and outputs can still be used.
- The measured values are stored as usual.

The FastFood mode has to be enabled and activated.

### 13.6.1 Enabling/Disabling the FastFood Mode

Enter HotCode **007022** immediately after the transmitter has been switched on.

```
Enable FastFood
no                >YES<
```

Select `yes` to enable the FastFood Mode, `no` to disable it.

### 13.6.2 Storage Rate of the FastFood Mode

Storage Rate	70	ms
--------------	----	----

If the FastFood mode is enabled, a `Storage Rate` in `ms` will have to be entered in the program branch `Output Options`.

Press **ENTER**.

### 13.6.3 Activation/Deactivation of the FastFood Mode

If the FastFood mode is enabled and a measurement is started, the normal measuring mode will still be running (i.e. multi-channel measurement with permanent adaptation to the measuring conditions). If the data logger is activated, the measured values will not be stored.

A:act. Volume flow	54.5	m3/h
--------------------	------	------

Press key **[0]** to activate/deactivate the FastFood mode for the measuring channel currently displayed.

A:Mode=FastFood	54.5	m3/h
-----------------	------	------

Scroll with key **[9]** in the upper line until the activated measuring mode `A:Mode=FastFood` or `A:Mode=TransTime` is displayed.

If the data logger is activated, a new data set will be created and storing of measured values will be started. If the FastFood mode is deactivated or if the measurement is interrupted, the storing will be stopped.

#### Note!

The values of the current measuring data set will be deleted if the FastFood mode is deactivated and activated again without interrupting the measurement.

The values of the current measuring data set will be kept if the measurement is interrupted before the FastFood mode is activated again. A new measuring data set is created when the next measurement is started.

## 13.7 Calculation Channels

In addition to the ultrasonic measuring channels, the transmitter has two virtual calculation channels Y and Z. The measured values of the measuring channels A and B can be used for calculations by the calculation channels.

The result of the calculation is the measured value of the selected calculation channel. This measured value is equivalent to the measured values of a measuring channel. All operations with the measured values of a measuring channel (totalizing, online transmission of data, storing, outputs, etc.) can also be done with the values of a calculation channel.

### 13.7.1 Characteristics of the Calculation Channels

In the program branch `Parameter`, the measuring channels to be used for the calculation and the calculation function have to be entered.

A calculation channel can not be attenuated. The damping factor has to be set separately for each of the two measuring channels.

Two cut-off flow values for each calculation channel can be defined. The cut-off flow is not based on the flow velocity as for measuring channels. Instead, it is defined in the unit of measurement of the physical quantity selected for the calculation channel. During the measurement, the calculated values are compared to the cut-off flow values and set to zero if necessary.

A calculation channel provides valid measured values if at least one measuring channel provides valid measured values.

### 13.7.2 Parameterization of a Calculation Channel

```
Parameter      ↑
for Channel    Y:
```

Select a calculation channel (Y or Z) in the program branch Parameter. Press ENTER.

```
Calculation:
Y= A - B
```

The current calculation function is displayed. Press ENTER to edit the function.



```
>CH1< funct ch2 ↑
  A      -      B
```

Three scroll lists are displayed in the upper line:

- selection of the first measuring channel (ch1)
- selection of the calculation function (funct)
- selection of the second measuring channel (ch2)

Select a scroll list with key  4 or .

The list items are displayed in the lower line.

Scroll with key  8 and  2 through the scroll list. All measuring channels and their absolute values can be used as input channels for the calculation.

The following calculation functions are available:

- -:  $Y = ch1 - ch2$
- +:  $Y = ch1 + ch2$
- (+)/2:  $Y = (ch1 + ch2) / 2$
- |-|:  $Y = |ch1 - ch2|$

Press ENTER.

### 13.7.3 Output Options for a Calculation Channel

```
Output Options ↑
for Channel    Y:
```

Select a calculation channel in the program branch Output Options. Press ENTER.

Physic. Quant.    ↑  
 Mass Flow

Select the physical quantity to be calculated. Press ENTER.

Make sure that the physical quantity selected for the calculation channel can be calculated from the physical quantities of the selected measuring channels. Possible combinations are shown in Tab. 13.2.

**Tab. 13.2: Physical quantity of the calculation channel**

physical quantity of the calculation channel	possible physical quantity of the first measuring channel (ch1)				possible physical quantity of the second measuring channel (ch2)			
	flow velocity	volumetric flow rate	mass flow rate		flow velocity	volumetric flow rate	mass flow rate	
flow velocity	x	x	x		x	x	x	
volumetric flow rate		x	x			x	x	
mass flow rate		x	x			x	x	

example:      The difference of the volume flow rates of the channels A and B is to be calculated.

The physical quantity of channel A and B can be the volumetric flow rate or the mass flow rate, but not the flow velocity. The physical quantities of the two measuring channels do not need to be identical (channel A = mass flow rate, channel B = volumetric flow rate).

Mass in:            ↑  
 kg/h

Select the unit of measurement. Press ENTER.

Two cut-off flow values for each calculation channel can be defined. They are defined in the unit of measurement of the physical quantity selected for the calculation channel.

+Cut-off Flow  
 1.00            kg/h

All positive calculated values that are lower than the limit will be set to 0.

-Cut-off Flow  
 -2.00            kg/h

All negative calculated values that are greater than the limit will be set to 0.

Store Meas.Data  
 >NO<            yes

The data logger can be activated/deactivated. Press ENTER.

### 13.7.4 Measuring with Calculation Channels

```
par >MEA< opt sf
Measuring
```

Select program branch **Measuring**. Press **ENTER**.

```
CHANN: A B >Y< Z
MEASUR ✓ ✓ ✓ .
```

Activate the necessary channels. Calculation channels are activated or deactivated in the same way as the measuring channels. Press **ENTER**.

```
WARNING! CHANNEL
      B: INACTIV!
```

If a measuring channel that is needed for an activated calculation channel has not been activated, a warning will be displayed. Press **ENTER**.

Position the transducers for all activated measuring channels. The measurement will be started automatically.

```
Y: Flow Velocity
    53.41      m/s
```

If a calculation channel is activated, the **HumanMux** mode (see section 12.2.2) will be selected at the beginning of the measurement and the values of the calculation channel will be displayed.

If the **AutoMux** mode is selected, the measured values of the measuring channels, but not the measured values of the calculation channels, will be displayed alternately.

```
Y: A - B
    53.41      m/s
```

Press key **9** to display the calculation function.

Press key **7** to display the measured values of the different channels.

### 13.8 Change of the Limit for the Inner Pipe Diameter

It is possible to change the lower limit of the inner pipe diameter for a given transducer type.

Enter HotCode **071001** immediately after the transmitter has been switched on.

```
DNmin Q-Sensor
    15      mm
```

Enter the lower limit of the inner pipe diameter of the displayed transducer type. Press **ENTER** to select the next transducer type.

#### Note!

If a transducer is used below its recommended inner pipe diameter, a measurement might be impossible.

## 14 Data Logger and Transmission of Data

The transmitter has a data logger in which the measured values are stored during the measurement (see section 14.1).

The measured values are transmitted to a PC via the serial interface directly during the measurement (see section 14.2).

For the connection of the serial interface see section 6.7.

### 14.1 Data Logger

The following data will be stored:

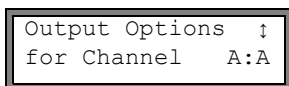
- date
- time
- measuring point number
- pipe parameters
- medium parameters
- transducer data
- sound path (reflection or diagonal mode)
- transducer distance
- damping factor
- storage rate
- physical quantity
- unit of measurement
- measured values (physical quantity and input quantities)
- totalizer values (if the totalizers are activated)
- diagnostic values (if storing of diagnostic values is activated)

In order to store the measured data, the data logger must be activated (see section 14.1.1).

The available data logger memory can be displayed (see section 14.1.6).

The storing of each measured value will be signaled acoustically. This signal can be deactivated (see section 14.1.3 in Acoustic Signal).

#### 14.1.1 Activation/Deactivation of the Data Logger



Select in the program branch `Output Options` the channel for which the data logger is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

```

Store Meas.Data
no                >YES<

```

Press ENTER until the menu item `Store Meas.Data` is displayed.

Select `yes` to activate the data logger. Press ENTER.

### 14.1.2 Setting the Storage Rate

The storage rate is the frequency at which the measured values are transmitted or stored. The storage rate will be set separately for each measuring channel.

If the storage rate is not set, the storage rate previously selected will be used.

The storage interval should be at least equal to the number of activated measuring channels, e.g. the storage interval of a channel should be min. 2 s if 2 measuring channels are activated, min. 4 s are recommended.

```

Storage Rate      ↑
Once per 10 sec.

```

Select a storage rate or `EXTRA`. Press ENTER.

This display will only be indicated if `Store Meas.Data` and/or `Serial Output` are activated.

```

Storage Rate
1              s

```

If `EXTRA` has been selected, enter the storage rate. Press ENTER.

### 14.1.3 Settings for the Data Logger

Select program branch `Special Funct.\SYSTEM settings\Storing`. It contains the following menu items:

- ringbuffer
- storage mode
- storing of the totalizer values
- storing of the signal amplitude
- storing of the sound speed
- acoustic signal during the storing

## Ringbuffer

The setting of ringbuffer affects the storing of measured values as soon as the data memory is full:

- If the ringbuffer is activated, the available data logger will be halved. The oldest measured values will be overwritten. Only the data logger memory that was free during the activation will be used by the ringbuffer. If more data logger memory is necessary, measured values in the data logger should be deleted previously.
- If the ringbuffer is deactivated, the storing of measured values will be stopped.

```
Ringbuffer
off          >ON<
```

Select the behavior of the ringbuffer. Press ENTER.

If `on` is selected, the available data logger memory will be halved. The oldest measured values will be overwritten.

If `off` is selected, the storing of measured values will be stopped.

## Storage Mode

```
Storage mode
>SAMPLE<   average
```

Select the storage mode. Press ENTER.

If `sample` is selected, the displayed measured value will be used for storing and online transmission of data.

If `average` is selected, the average of all values measured during a storage interval will be used for storing and online transmission of data.

<b>Note!</b>	The storage mode does not affect the outputs.
--------------	---

<b>Note!</b>	<p>Storage mode = average</p> <p>The average of the physical quantity and other physical quantities assigned to the measuring channel, e.g. the measured temperature, will be calculated.</p> <p>If the storage rate &lt; 5 s (see section 14.1.2) is selected, <code>sample</code> will be used.</p> <p>If no average could be calculated over the complete storage interval, the value will be marked as invalid. The ASCII file will contain "???" instead of invalid average values of the physical quantity and "?UNDEF" instead of invalid temperatures.</p>
--------------	--

## Storing of the Totalizers

see section 13.2, Selection of the Totalizers for Storing

## Storing of the Signal Amplitude

```
Store Amplitude
off          >ON<
```

If `on` is selected and the data logger is activated, the amplitude of the measured signal will be stored together with the measured values. Press ENTER.

## Storing of the Sound Speed of the Medium

```
Store c-Medium
off                >ON<
```

If **on** is selected and the data logger is activated, the sound speed of the medium will be stored together with the measured values. Press ENTER.

## Storing of the Diagnostic Values

```
Store diagnostic
off                >ON<
```

If **on** is selected and the data logger is activated, the diagnostic values will be stored together with the measured values. Press ENTER.

## Acoustic Signal

Per default, an acoustic signal will be emitted every time a measured value is stored or transmitted to a PC or printer. The signal can be deactivated in `Special Funct.\SYSTEM settings\Storing\Beep on storage`.

```
Beep on storage
>on<                off
```

Select **off** to deactivate the acoustic signal, **on** to activate it. Press ENTER.

### 14.1.4 Measurement with Activated Data Logger

- Start the measurement.

```
A:Meas.Point No.:
xxx (↑↓← →)
```

Enter the measuring point number. Press ENTER.

If arrows are displayed in the lower line on the right, ASCII text can be entered. If digits are displayed, only digits, point and hyphen can be entered.

For the setting of the input mode see section 17.2.3.

If `Output Options\Store Meas.Data` has been activated and `Special Funct.\SYSTEM settings\Ringbuffer` is deactivated, this error message will be displayed as soon as the data logger is full.

```
DATA MEMORY
OVERFLOW!
```

Press ENTER.

The error message will be displayed periodically.

If no other output (transmission of data, outputs) has been activated, the measurement will be stopped.

If another output has been activated, the measurement will be continued. Only the storing of the measured values will be stopped.

### 14.1.5 Deleting the Measured Values

```
Special Funct.  ↑
Delete Meas.Val.
```

Select Special Funct.\Delete Meas.Val. Press ENTER.

```
Really Delete?
no              >YES<
```

Select yes or no. Press ENTER.

### 14.1.6 Available Data Logger Memory

If the data logger is empty and a measurement is started with one physical quantity on one measuring channel without storing the totalizer, approx. 100 000 measured values can be stored. The available data logger memory can be displayed:

```
Special Funct.  ↑
Instrum. Inform.
```

Select Special Funct.\Instrum. Inform.. Press ENTER.

```
G60X-XXXXXXXXX
Free:          18327
```


The type and the serial number of the transmitter will be displayed in the upper line.

The available data logger memory will be displayed in the lower line (here: 18 327 additional measured values can be stored). Press key BRK twice to return to the main menu.

Max. 100 measuring data sets can be stored. The number of measuring data sets depends on the total number of measured values stored in the previous measuring data sets.

The time at which the data logger memory will be full can be displayed during the measurement. All activated channels, totalizers and other values will be considered.

```
full= 26.01/07:39
      54.5      m3/h
```

Scroll through the displays of the upper line with key  during measurement.

```
last= 26.01/07:39
      54.5      m3/h
```

If the ringbuffer is activated and has overflowed at least once, this display will be indicated.

## 14.2 Transmission of Data

The measured values can be transmitted to a PC via the serial interface RS232.

### 14.2.1 Online Transmission of Data

The measured values are transmitted during the measurement. If the data logger is activated, the measured values will also be stored.

Tab. 14.1: Overview online transmission of data

serial interface	transmission of data	see
RS232	terminal program	section 14.2.5

### 14.2.2 Offline Transmission of Data

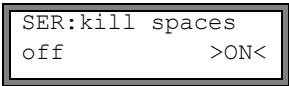
The measurement data of the data logger are transmitted.

Tab. 14.2: Overview offline transmission of data

serial interface	transmission of data	see
RS232	terminal program	section Offline Transmission of Data to a Terminal Program
RS232	FluxData	section 14.2.7

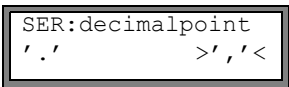
### 14.2.3 Formatting of the Measurement Data

Select Special Funct.\SYSTEM settings\serial transmis.



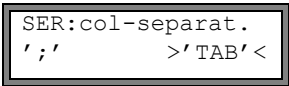
Select on if the space characters are not to be transmitted. Press ENTER.

The file size will be considerably smaller (shorter transmission time).



Select the decimal marker to be used for floating-point numbers (point or comma). Press ENTER.

This setting depends on the setting of the operating system of the PC.



Select the character to be used to separate columns (semicolon or tabulator). Press ENTER.

### 14.2.4 Transmission Parameters

- the transmitter sends CRLF-terminated ASCII
- max. line length: 255 digits

## RS232

- default: 9600 bits/s, 8 data bits, even parity, 2 stop bits, protocol RTS/CTS (hardware, handshake)

The transmission parameters of the RS232 interface can be changed:

Enter HotCode **232-0**- immediately after the transmitter has been switched on.

```
baud<data par st
9600 8bit EVEN 2
```

Set the transmission parameters in the 4 scroll lists. Press EN-TER.

- baud: baud rate
- data: number of data bits
- par: parity
- st: number of stop bits

### 14.2.5 Online Transmission of Data to a Terminal Program

- Start the terminal program.
- Enter the transmission parameters into the terminal program (see section 14.2.4). The transmission parameters of the terminal program and of the transmitter have to be identical.
- Select the program branch `Output Options`. Press ENTER.
- Select the channel for which the online transmission of data is to be activated. Press ENTER until the menu item `Serial Output` is displayed.

```
Serial Output
no                >YES<
```

Select `yes` to activate the online transmission of data.

- Set the storage rate (see section 14.1.2).
- Start the measurement. The measuring point number will be requested (see section 14.1.4).

```
SEND ONLINE-HEAD
20                mm
```

The measured values are transmitted during the measurement.

### 14.2.6 Offline Transmission of Data to a Terminal Program

- Start the terminal program.
- Enter the transmission parameters into the terminal program (see section 14.2.4). The transmission parameters of the terminal program and of the transmitter have to be identical.

```
Special Funct.  ↑
Print Meas.Val.
```

Select `Special Funct.\Print Meas.Val..` Press ENTER.

```
NO VALUES      !
Print Meas.Val.
```

This error message will be displayed if no measured values are stored. Press ENTER.

```
Send Header      01
.....
```

This message will be displayed if the measuring signal is sufficient.

```
■■■■■■■■
.....
```

The progress of the transmission of data is displayed by a bar graph.

```
SERIAL ERROR    !
Print Meas.Val.
```

This error message will be displayed if an error has occurred during the serial transmission. Press ENTER. Check the connections and make sure that the PC is ready to receive data.

### 14.2.7 Offline Transmission of Data with the Program FluxData

The measurement data in the data logger are transmitted to a PC via the serial interface RS232 with the FLEXIM program FluxData.

#### Settings in the transmitter

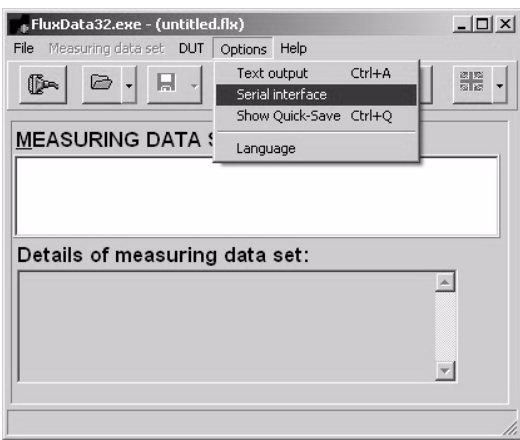
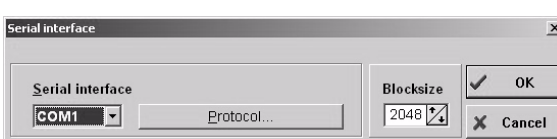
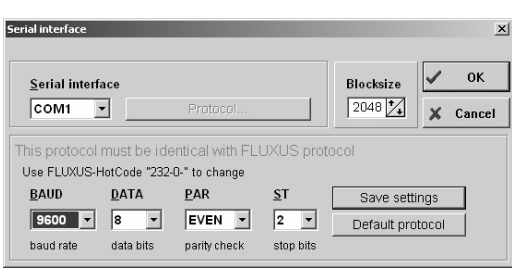
```
par mea opt >sf<
Special Funct.
```

Press BRK to select the main menu.

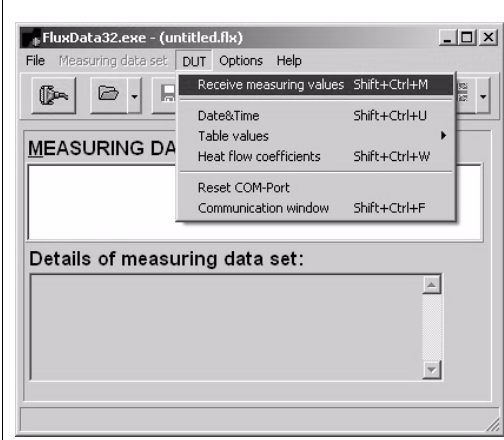
Further settings in the transmitter are not necessary.

Settings in the Program

Start the program FluxData V3.0 or higher on the PC.

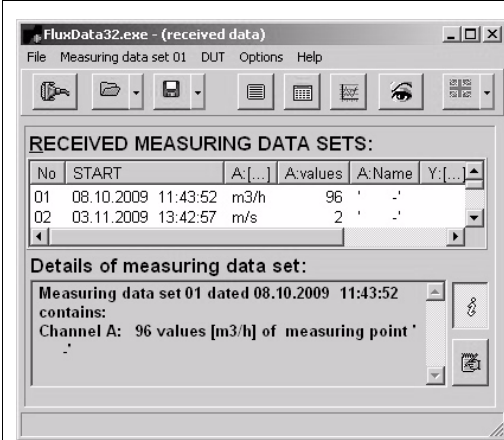
	<p>Select the menu: Options &gt; Serial interface.</p>
	<p>Select the serial interface used from the PC (e.g. COM1). Click on OK. Protocol Click on OK.</p>
	<p>Enter the transmission paramet- ers (see section 14.2.4). If the default settings of the transmis- sion parameters are be used, click on Default protocol.</p> <p>The transmission parameters of the program FluxData and of the transmitter have to be iden- tical.</p> <p>Click on OK.</p>

Transmission of Data

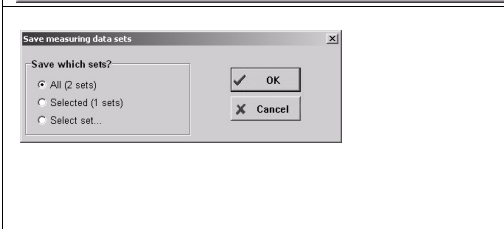


Select the menu:  
DUT > Receive measuring values.  
Wait until the data are transmitted.

Stop of the Transmission of Data



Select the menu:  
File > Save.



Select the series of measurement to be stored. Click on OK.  
Select the path on which the data should be stored. Enter the file name. Click on Save.  
The file will be stored with the file extension .flx.

### 14.2.8 Structure of the Data

The header is transmitted at the beginning of the measurement. The first 4 lines contain general information about the transmitter and the measurement. The following lines contain the parameters of each channel.

```
Example:  \DEVICE          : G60X-XXXXXXX
          \MODE           : ONLINE
          DATE            : 2011-01-09
          TIME            : 19:56:52
          Par.Record
          Meas.Point No.: : A:F5050
          Pipe
            Outer Diameter : 60.3 mm
            Wall Thickness  : 5.5 mm
            Roughness       : 0.1 mm
            Pipe Material   : Carbon Steel
            Lining          : WITHOUT LINING
          Medium           : Natural gas user
            Medium Temperat. : 38 C
            Fluid pressure   : 60.00 bar
          Transducer Type  : xxx
          Sound Path       : 3 NUM
          Transd. Distance : -15.6 mm
          Damping          : 20 s
          Full-Scale Val.  : 4.50 m3/h
          Physic. Quant.   : act. Volume flow
          Unit Of Measure  : [m3/h]/[m3]
          Numb.Of Meas.Val : 100
```

The line \DATA will be transmitted next. Afterwards the column titles will be transmitted for the respective channel (see Tab. 14.3) The measured values are transmitted afterwards.

```
Example:  \DATA
          A:  \*MEASURE;   Q_POS;           Q_NEG;
          B:  \*MEASURE;   Q_POS;           Q_NEG;
```

In every storage interval, one data line per activated measuring channel is transmitted. The line "???" will be transmitted if there are no measured values available for the storage interval.

example: With a storage interval of 1 s, 10 lines "???" will be transmitted if the measurement has been restarted after a 10 s interruption for the positioning of the transducers.

The following data columns can be transmitted:

**Tab. 14.3: Columns of data**

column title	column format	contents
\*MEASURE	###000000.00	physical quantity selected in Output Options
Q_POS	+00000000.00	totalizer value for the positive flow direction
Q_NEG	-00000000.00	totalizer value for the negative flow direction
FQ_POS		value of the totalizer for the positive flow direction (if the heat flow has been selected as the physical quantity)
FQ_NEG		the value of the totalizer for the negative flow direction (if the heat flow has been selected as the physical quantity)
T1	###000.0	temperature T1 (= supply temperature if the heat flow has been selected as the physical quantity)
T2	###000.0	temperature T2 (= return temperature if the heat flow has been selected as the physical quantity)
...		designation for other inputs
SSPEED		sound speed of the medium
AMP		signal amplitude

### Online Transmission of Data

Columns will be created for all quantities that appear during the measurement. The columns Q\_POS and Q\_NEG will remain empty if the totalizers are deactivated.

As the totalizers can not be activated for the physical quantity flow velocity, these columns will not be created.

### Offline Transmission of Data

During the offline output, columns will only be created if at least one measured value is stored in the data set. The columns Q\_POS and Q\_NEG will not be created if the totalizers are deactivated.

## 15 Working with Parameter Records

### 15.1 Introduction

Parameter records are data sets that contain all information necessary to perform a certain measurement task:

- pipe parameters
- transducer parameters
- medium parameters
- output options

Working with parameter records will make repeated measurement tasks easier and faster. The transmitter can store max. 14 parameter records.

**Note!** No parameter records are stored in the delivery state. Parameter records are entered manually.

### 15.2 Storing of a Parameter Record

The parameters must first be entered in the program branch `Parameter`. Afterwards, they can be stored as a parameter record.

```
Special Funct.  ↑
Store Curr.Rec.
```

Select `Special Funct.\Store Curr.Rec..` Press ENTER.

```
NO DATA!
Store Curr.Rec.
```

This error message will be displayed if no complete parameter record is available. Storing is impossible. Enter the missing parameters in the program branch `Parameter`.

```
Store Par. To:  ↑
Par.Record      01
```

14 parameter records (`Par.Record 01...Par.Record 14`) can be stored. Select a parameter record. Press ENTER.

```
Overwrite
no          >YES<
```

If parameters are already stored in the selected parameter record, they can be overwritten.

Select `yes` to overwrite the parameters, or `no` to select another parameter record. Press ENTER.

### 15.3 Loading of a Parameter Record

Stored parameter records can be loaded and used for measurement.

```
>PAR<mea opt sf
Parameter
```

Select program branch `Parameter`. Press ENTER.

```

Parameter      ↑
for Channel    A:

```

Select the channel for which a parameter record is to be loaded. Press ENTER.

```

Parameter from: ↑
Par.Record      01

```

Select the parameter record to be loaded. Press ENTER.

```

Edit Parameters
>NO<           yes

```

Select **yes** to edit the parameters of a parameter record.  
Select **no** to return to the main menu and start the measurement.

Press ENTER.

## 15.4 Deleting Parameter Records

```

Special Funct.  ↑
Delete Para.Rec.

```

Select **Special Funct.\Delete Para.Rec..** Press ENTER.

```

NO PAR. STORED! !
Delete Para.Rec.

```

This error message will be displayed if no parameter records are stored. Press ENTER.

```

Delete:         ↑
Par.Record      01

```

This display will be indicated if parameter records are stored.

Select the parameter record to be deleted. Press ENTER.

```

Really Delete?
no             >YES<

```

Confirm whether to delete the parameter record. Press ENTER.

## 16 Libraries

The internal material database of the transmitter contains parameters for pipe and lining materials as well as for media. It can be extended with user defined materials or media. User defined materials and media will always be displayed in the scroll lists of the program branch `Parameter`.

User defined materials and media can be stored in an integrated coefficient memory (user area). The coefficient memory has to be partitioned first (see section 16.1).

The properties of user defined materials or media can be entered as follows:

- as constants without the extended library (see section 16.2)
- as constants or temperature and pressure dependent functions by means of the extended library (see section 16.3)

The material and media scroll lists displayed in the program branch `Parameter` can be arranged (see section 16.5). Shorter scroll lists make working more efficient.

### 16.1 Partitioning of the Coefficient Memory

The coefficient memory can be divided into parts for the following material data:

- material properties:
  - transversal and longitudinal sound speed
  - typical roughness
- medium properties:
  - min. and max. sound speed
  - kinematic viscosity
  - density
  - gas compressibility factor

For the max. number of data sets for each category of these material data see Tab. 16.1.

**Tab. 16.1: Capacity of the coefficient memory**

	max. number of data sets	occupancy of the coefficient memory in %
materials	13	97
media	13	97

```
Libraries      ↑
Format USER-AREA
```

Select Special Funct.\SYSTEM settings\ Libraries\Format USER-AREA. Press ENTER.

```
MAXIMAL:      13!
Materials:     15
```

This error message will be displayed if the entered number of data sets for a category of material data exceeds the capacity of the coefficient memory.

```
Format USER-AREA
Materials:      03
```

Enter the number of the user defined materials. Press ENTER.

```
Format USER-AREA
Media:         03
```

Enter the number of the user defined media. Press ENTER.

```
USER AREA:
52%          used
```

The occupancy of the coefficient memory is displayed for a few seconds.

```
Format NOW?
no           >YES<
```

Select `yes` to start the partitioning. Press ENTER.

```
FORMATTING ...
■■■■■■■ ...
```

The coefficient memory will partitioned accordingly. This procedure takes a few seconds.

```
Libraries      ↑
Format USER-AREA
```

After the partitioning, `Format USER-AREA` is displayed again.

### 16.1.1 Data Retention During the Partitioning of the Coefficient Memory

When the coefficient memory is repartitioned, max. 8 data sets of each type can be retained.

example 1: The number of user defined materials is reduced from 5 to 3. The data sets #01 to #03 are retained. The data sets #04 and #05 are deleted.

example 2: The number of user defined materials is increased from 5 to 6. All 5 data sets are kept.

## 16.2 Input of Material/Medium Properties Without the Extended Library

To enter the material/medium properties as constants, the extended library must be deactivated.

```
Libraries      ↑
Extended Library
```

Select `Special Funct.\SYSTEM settings\Libraries\Extended Library`. Press ENTER.

```
Extended Library
>OFF<          on
```

Select `off` to deactivate the extended library. Press ENTER.

The properties of a user defined material/medium can be entered now.

The input of a material or a medium is almost identical. Therefore, displays for a medium will only be shown and described in case of differences.

```
Special Funct.  ↑
Install Material
```

Select Special Funct.\Install Material or Install Medium. Press ENTER.

```
USER Material
NOT FORMATTED !
```

This error message will be displayed if the coefficient memory does not contain an area for user defined materials/media.

Partition the coefficient memory accordingly (see section 16.1).

```
Install Material
>EDIT<      delete
```

Select edit. Press ENTER.

```
USER Material  ↑
#01:--not used--
```

Select a user defined material/medium. Press ENTER.

```
EDIT TEXT (↑↓←→)
USER MATERIAL  1
```

Change the designation of the material/medium.

The default name for a user defined material/medium is USER MATERIAL N or USER MEDIUM N with N being an integer.

### Note!

95 ASCII characters (letters, capital letters, numbers, special characters [! ? " + - ( ) > < % \* etc.]) are available for the designation of materials/media.

A designation can have max. 16 characters. The input of text is described in section 4.4.

## Material properties

```
c-Material
1590.0      m/s
```

Enter the sound speed of the material. Press ENTER.

For the sound speed of some materials annex C.1.

```
Roughness
0.4      mm
```

Enter the roughness of the material. Press ENTER.

For the typical roughness of some materials see annex C.2.

## Medium properties

c-Medium	MIN
1400.0	m/s

Enter the min. and max. sound speed of the medium.  
Press ENTER.

c-Medium	MAX
1550.0	m/s

Kinem.Viscosity	
1.01	mm <sup>2</sup> /s

Enter the kinematic viscosity of the medium. Press ENTER.

Density	
60.00	kg/m <sup>3</sup>

Enter the density of the medium. Press ENTER.

## 16.3 Extended Library

### 16.3.1 Introduction

If the extended library is activated, it is possible to enter material and medium properties as a function of the temperature or of the pressure. These data can be entered into the transmitter directly or by means of the program FluxKoef.

**Tab. 16.2: Material and medium properties that can be stored**

property	property is necessary for...
<b>material property</b>	
transversal sound speed	flow measurement
longitudinal sound speed	flow measurement, wall thickness measurement (G601)
type of sound wave	flow measurement
typical roughness	profile correction of the flow velocity
<b>medium property</b>	
sound speed	start of measurement
viscosity	profile correction of the flow velocity
density	calculation of mass flow rate
gas compressibility factor	standard volumetric flow rate

Enter only the properties needed for the measuring task.

The dependency of the material/medium properties from the temperature and pressure can be described

- as constants
- as linear function
- with polynomials of grade 1 to 4
- with customized interpolation functions

In most cases, constants or a linear function are sufficient.

If e.g. the temperature fluctuations at the measuring point are low compared to the temperature dependency of the material properties, the linearization or the complete neglect of the temperature dependency will not result in a considerable additional measuring error.

If, however, the process conditions fluctuate strongly and the medium properties depend strongly on the temperature (e.g. viscosity of a hydraulic oil), polynomials or customized interpolation functions should be used. Contact FLEXIM to find the best solution for the measuring task.

### Customized Interpolation Functions

Some dependencies are only approximated insufficiently by polynomials. A number of customized interpolation functions **Basics:  $Y=F(X, Z)$**  are available to interpolate multidimensional dependencies  $y = f(T, p)$ . Contact FLEXIM for more information.

#### 16.3.2 Activation of the Extended Library

```
Extended Library
off                >ON<
```

Select Special Funct.\SYSTEM settings\ Libraries\Extended Library. Press ENTER.

Select on to activate the extended library. Press ENTER.

#### 16.3.3 Input of Material/Medium Properties

The properties of a user defined material/medium can be entered now.

The input of a material or a medium is almost identical. Therefore, the displays for a medium will only be shown and described in case of differences.

```
Special Funct.  ↓
Install Material
```

Select Special Funct.\Install Material or Install Medium. Press ENTER.

```
USER Material
NOT FORMATTED !
```

An error message will be displayed if the coefficient memory does not contain an area for user defined materials/media.

Partition the coefficient memory accordingly (see section 16.1).

```
Edit Material  ↑
Basics:Y=m*X +n
```

Select the function for the temperature or pressure dependency of the material/medium properties:

$Y = \text{const.} : \text{constants}$

$Y = M \cdot X + N$ : linear function of the temperature

$Y = \text{Polynom: } y = k_0 + k_1 \cdot x + k_2 \cdot x^2 + k_3 \cdot x^3 + k_4 \cdot x^4$

$Y = F(X, Z)$ : customized interpolation function (only for experienced users or after consultation with FLEXIM)

go back: return to the precedent menu item

```
USER Material  ↑
#01:--not used--
```

Select a user defined material/medium.

```
USER MATERIAL  2
>EDIT<         delete
```

Select edit to edit the material/medium properties or delete to delete the material/medium and to return to the scroll list Edit Material or Edit Medium.

This display will only be indicated if an already existing material/medium has been selected.

```
#2: Input Name:
USER MATERIAL  2
```

Enter the designation of the material/medium. Press ENTER.

The default name for a user defined material/medium is USER MATERIAL N or USER MEDIUM N with N being an integer.

## Material Properties

Enter the material's:

- transversal sound speed
- longitudinal sound speed

1...5 values depending on the selected function must be entered. Press ENTER after each input.

If an already defined material is edited, for each property there will be a request whether it is to be edited. Select yes or no. Press ENTER. Change the values, if necessary.

```
Default soundsp.
long.    >TRANS.<
```

Select the type of sound wave to be used for the flow measurement. Press ENTER.

For most materials, a transversal sound wave must be selected.

```
Roughness
0.4      mm
```

Enter the typical roughness of the material. Press ENTER.

```
Save changes
no       >YES<
```

Select yes to store the entered properties or no to quit the menu item without storing. Press ENTER.

## Medium Properties

Enter the medium's:

- longitudinal sound speed
- kinematic viscosity
- density
- gas compressibility factor

Depending on the selected function, 1...5 values must be entered. Press ENTER after each input.

If an already defined medium is edited, for each property of some of the functions there will be a request whether it is to be edited. Select `yes` or `no`. Press ENTER. Change the values, if necessary.

```
Save changes
no                >YES<
```

Select `yes` to store the entered properties, `no` to quit the menu item without storing. Press ENTER.

## 16.4 Deleting a User Defined Material/Medium

To delete a user defined material/medium, proceed as follows:

Select `Special Funct.\Install Material` or `Install Medium`. Press ENTER.

If the extended library is activated, press ENTER until the request for deleting is displayed.

```
Install Material
edit          >DELETE<
```

Select `delete`. Press ENTER.

```
USER Material
#01: Polystyrol
```

Select the material/medium to be deleted. Press ENTER.

```
Really Delete?
no                >YES<
```

Select `yes` or `no`. Press ENTER.

## 16.5 Arrangement of the Material/Medium Scroll List

The materials and media to be displayed in the program branch `Parameter` are arranged in the material scroll list and in the medium scroll list.

**Note!**

User defined materials/media will always be displayed in the scroll lists of the program branch `Parameter`.

```
SYSTEM settings ↓
Libraries
```

Select `Special Funct.\SYSTEM settings\Libraries`. Press `ENTER`.

```
Libraries ↓
Material list
```

Select `Material list` to edit the material scroll list or `Medium list` to edit the medium scroll list.

Select `go back` to return to `SYSTEM settings`. Press `ENTER`.

```
Material list
factory >USER<
```

Select `factory` if all materials/media of the internal database are to be displayed in the scroll list. An already existing scroll list will not be deleted but only deactivated.

Select `user` to activate the user defined scroll list. Press `ENTER`.

```
Material list ↓
>Show list
```

If `user` has been selected, the material or medium scroll list can be edited (see section 16.5.1...16.5.3).

```
Material list ↓
>End of Edit
```

Select `End of Edit` to stop editing. Press `ENTER`.

```
Save List ?
no >YES<
```

Select `yes` to store all changes of the scroll list or `no` to quit the menu item without storing. Press `ENTER`.

**Note!**

If the material/medium scroll list is quit by pressing key `BRK` before storing, all changes will be lost.

### 16.5.1 Displaying a Scroll List

```
Material list ↓
>Show list
```

Select `Show list`. Press `ENTER` to display the scroll list as in the program branch `Parameter`.

```
Current list= ↓
Other Material
```

The current scroll list is displayed in the lower line.

Press `ENTER` to return to the scroll list `Material list` or `Medium list`.

### 16.5.2 Adding a Material/Medium to the Scroll List

```
Material list  ↑
>Add Material
```

Select `Add Material` or `Add Medium` to add a material/medium to the scroll list. Press ENTER.

```
>Add Material  ↑
Stainless Steel
```

All materials/media that are not contained in the current scroll list will be displayed in the lower line.

Select the material/medium. Press ENTER. The material/medium will be added to the scroll list.

**Note!**

The materials/media are displayed in the order in which they have been added.

### 16.5.3 Adding all Materials/Media to the Scroll List

```
Material list  ↑
>Add all
```

Select `Add all` to add all materials/media of the database to the current scroll list. Press ENTER.

### 16.5.4 Removing a Material/Medium from the Scroll List

```
Material list  ↑
>Remove Material
```

Select `Remove Material` or `Remove Medium` to remove a material/medium from the scroll list. Press ENTER.

```
>Remove Material↑
Stainless Steel
```

All materials/media of the current scroll list will be displayed in the lower line.

Select the material/medium. Press ENTER. The material/medium will be removed from the scroll list.

**Note!**

User defined materials/media will always be displayed in the scroll lists of the program branch `Parameter`. They can not be removed.

### 16.5.5 Removing all Materials/Media from the Scroll List

```
Material list  ↑
>Remove all
```

Select `Remove all` to remove all materials/media from the scroll list. Press ENTER. User defined materials/media will not be removed.

## 17 Settings

### 17.1 Time and Date

The transmitter has a battery-powered clock. Measured values are automatically stored with the date and time.

#### 17.1.1 Time

```
SYSTEM settings ↓
Set Clock
```

Select **Special Funct.\SYSTEM settings\Set Clock**. Press **ENTER**.

```
TIME          11:00
ok            >NEW<
```

The current time is displayed. Select **ok** to confirm the time or **new** to set the time. Press **ENTER**.

```
TIME          11:00
Set Time      !
```

Select the digit to be edited with key **4** and **6**.

Edit the selected digit with key **8** and **2**. Press **ENTER**.

```
TIME          11:11
>OK<         new
```

The new time is displayed. Select **ok** to confirm the time or **new** to set the time again. Press **ENTER**.

#### 17.1.2 Date

After the time has been set, **DATE** is displayed.

```
DATE 2011-01-25
ok            >NEW<
```

Select **ok** to confirm the date or **new** to set the date. Press **ENTER**.

```
DATE 2011-01-25
Set Date      !
```

Select the digit to be edited with key **4** and **6**.

Edit the selected digit with key **8** and **2**. Press **ENTER**.

```
DATE 2011-01-26
>OK<         new
```

The new date is displayed. Select **ok** to confirm the date or **new** to set the date again. Press **ENTER**.

## 17.2 Dialogs and Menus

SYSTEM settings ↓  
Dialogs/Menus

Select Special Funct.\SYSTEM settings\Dialogs/Menus. Press ENTER.

### Note!

The settings of the menu item Dialogs/Menus will be stored at the end of the dialog. If the menu item is quit before the end of the dialog, the settings will not be effective.

### 17.2.1 Pipe Circumference

Pipe Circumfer.  
off >ON<

Select on if the pipe circumference is to be entered instead of the pipe diameter in the program branch Parameter. Press ENTER.

Outer Diameter  
100.0 mm

If on has been selected for Pipe Circumfer., the outer pipe diameter will nevertheless be requested in the program branch Parameter.

To select the menu item Pipe Circumfer., enter 0 (zero). Press ENTER.

Pipe Circumfer.  
314.2 mm

The value displayed in Pipe Circumfer. is calculated on the basis of the last displayed value of the outer pipe diameter.

example:  $100 \text{ mm} * \pi = 314.2 \text{ mm}$

Pipe Circumfer.  
180 mm

Enter the pipe circumference. The limits for the pipe circumference are calculated on the basis of the limits for the outer pipe diameter.

Outer Diameter  
57.3 mm

During the next scroll through the program branch Parameter, the outer pipe diameter that corresponds to the entered pipe circumference will be displayed.

example:  $180 \text{ mm} : \pi = 57.3 \text{ mm}$

### Note!

The pipe circumference is only edited temporarily. When the transmitter switches back to the display of the pipe circumference (internal recalculation), slight rounding errors may occur.

example: entered pipe circumference: 100 mm  
displayed outer pipe diameter: 31.8 mm

When the transmitter switches back to the display of the pipe circumference, 99.9 mm will be displayed.

### 17.2.2 Medium Pressure

The dependency of the properties of a medium on the pressure can be taken into account.

This display will only be indicated if `Special Funct.\SYSTEM settings\Measuring\Gas-Measuring` is deactivated. If `Gas-Measuring` is activated, the medium pressure will always be requested in the program branch `Parameter..`

```
Fluid pressure
off                >ON<
```

If `on` has been selected, the medium pressure will be requested in the program branch `Parameter..`

If `off` has been selected, 1 bar will be used for all calculations.

#### Note!

For documentation purposes, it is useful to enter the medium pressure, even if the transmitter contains no pressure-dependent characteristic curves.

### 17.2.3 Measuring Point Number

```
Meas.Point No.:
(1234)  >(↑↓← →)<
```

Select `1234` if the measuring point is to be identified only by numbers, point and dash.

Select `↑↓← →` if the measuring point is to be identified by the ASCII editor.

### 17.2.4 Transducer Distance

```
Transd. Distance
auto                >USER<
```

recommended setting: `user`

- `user` will be selected if the measuring point is always the same.
- `auto` can be selected if the measuring point changes often.

```
Transd. Distance?
(50.8) 50.0 mm
```

In the program branch `Measuring`, the recommended transducer distance will be displayed in parentheses, followed by the entered transducer distance if the recommended and the entered transducer distance are not identical.

```
Transd. Distance?
50.8      mm
```

During transducer positioning in the program branch `Measuring`

- only the entered transducer distance will be displayed if `Transd. Distance = user` has been selected and the recommended and the entered transducer distances are identical
- only the recommended transducer distance will be displayed if `Transd. Distance = auto` has been selected.

### 17.2.5 Temperature Correction

```

Corr.Offset
off          >ON<

```

Select **on** to enable the input of a temperature correction for each temperature input (see section 20.5).

### 17.2.6 Error Value Delay

The error value delay is the time after which an error value will be sent to an output if no valid measured values are available.

```

Error-val. delay
damping        >EDIT<

```

Select **edit** to enter an error value delay. Select **damping** if the damping factor is to be used as the error value delay.

For further information on the behavior of missing measured values see section 21.1.2 and 21.2.

### 17.2.7 Alarm State Indication

```

SHOW RELAIS STAT
off            >ON<

```

Select **on** to display the alarm state during the measurement.

For further information on the alarm outputs see section 21.6.

### 17.2.8 Preferred Units

It is possible to set the preferred units for the length, temperature and pressure:

```

Length unit
>[mm]<      [inch]

```

Select **mm** or **inch** as the preferred unit for the length. Press **ENTER**.

```

Temperature
>[°C]<      [°F]

```

Select **°C** or **°F** as the preferred unit for the temperature. Press **ENTER**.

```

Pressure
>[bar]<      [psi]

```

Select **bar** or **psi** as the preferred unit for the pressure. Press **ENTER**.

### 17.2.9 Setting for the Medium Pressure

It is possible to set whether the absolute or the relative pressure will be used:

Pressure absolut  
off >ON<

Select **on** or **off**. Press ENTER.

If **on** has been selected, the absolute pressure  $p_a$  will be displayed/input/output.

If **off** has been selected, the relative pressure  $p_g$  will be displayed/input/output.

$$p_g = p_a - 1.01 \text{ bar}$$

Fluid pressure  
1.00 bar(a)

The pressure and its unit of measurement will e.g. be displayed in the program branch **Parameter**. It will be followed by the selected pressure, indicated in parentheses.

a - absolute pressure

g - relative pressure

**Note!** The standard pressure in Special Funct.\SYSTEM settings\Gas-Measuring\Normal pressure is entered as the absolute pressure.

**Note!** All changes will be stored at the end of the dialog.

## 17.3 Measurement Settings

SYSTEM settings ↓  
Measuring

Select Special Funct.\SYSTEM settings\Measuring. Press ENTER.

**Note!** The settings of the menu item **Measuring** will be stored at the end of the dialog. If the menu item is quit before the end of the dialog, the settings will not be effective.

Gas-Measuring  
off >ON<

Select **on** to activate the gas measurement, **off** to deactivate it. Press ENTER.

Compare c-fluid  
no >YES<

Select **yes** if the measured sound speed is to be compared to the theoretical or expected value. The difference

$$\Delta c = c_{\text{mea}} - c_{\text{stored}}$$

between the two sound speeds will be displayed during the measurement.  $c_{\text{stored}}$  is the sound speed stored in the database.

Press key **9** during the measurement to scroll to the display of  $\Delta c$ .

```
Flow Velocity
>NORMAL<   uncorr.
```

Select **normal** to display and transmit the profile corrected flow values, **uncorr.** to display and transmit the flow values without flow profile correction. Press ENTER.

For further information see section 13.5.

```
Cut-off Flow
absolut    >SIGN<
```

A lower limit for the flow velocity can be entered (see section 13.4).

```
Cut-off Flow
factory    >USER<
```

```
Velocity limit
24.0      m/s
```

An upper limit for the flow velocity can be entered (see section 13.3).

Enter 0 (zero) to deactivate the flow velocity check.

```
Quant. wrapping
off       >ON<
```

Select the overflow behavior of the totalizers (see section 13.2.1).

```
Quantity recall
off       >ON<
```

Select **on** to keep the previous totalizer values after a restart of the measurement.

Select **off** to reset the totalizers to zero after a restart of the measurement.

```
Turbulence mode
off       >ON<
```

The activation of the turbulence mode can improve the signal quality if the flow is highly turbulent (e.g. in the vicinity of an elbow or valve). An SNR value of min. 6 dB is required during the measurement.

### Note!

All changes will be stored at the end of the dialog.

## 17.4 Settings of the Standard Conditions for the Gas Measurement

```
SYSTEM settings ↑
Gas-Measuring
```

Select **Special Funct.\SYSTEM settings\Gas-Measuring**. Press ENTER.

This display will only be indicated if the gas measuring has been activated in **Special Funct.\SYSTEM settings\Measuring**.

```
Normal pressure
1.01325    bar
```

Enter the pressure for the local standard conditions.

```
Normal temper.
0.0        C
```

Enter the temperature for the local standard conditions.


## 17.5 Setting the Contrast


SYSTEM settings ↑  
Miscellaneous


SETUP DISPLAY  
← CONTRAST →


Select Special Funct.\SYSTEM settings\ Miscellaneous to set the contrast of the display of the transmitter. Press ENTER.


The contrast of the display is adjusted with the following keys:

 **6** to increase the contrast

 **4** to decrease the contrast

 **2** = min. contrast

 **5** = medium contrast

 **8** = max. contrast

**Note!** After a cold start, the display will be reset to medium contrast.

## 17.6 Instrument Information

Special Funct. ↑  
Instrum. Inform.

G60X-XXXXXXXX  
Free: 18327

Select Special Funct.\Instrum. Inform. to display information about the transmitter. Press ENTER.

The type and the serial number of the transmitter will be displayed in the upper line.

The max. available data logger memory will be displayed in the lower line (here: 18 327 additional measured values can be stored). For further information on the data logger see section 14.1.6.

Press ENTER.

G60X-XXXXXXXX  
V x.xx dd.mm.yy

The type and the serial number of the transmitter will be displayed in the upper line.

The firmware version of the transmitter with date is displayed in the lower line.

Press ENTER.

## 18 SuperUser Mode

The SuperUser mode offers the possibility of an advanced analysis of the signal and the measured values as well as the definition of additional parameters adapted to the measuring point, in order to achieve better measuring values or during experimental work. Features of the SuperUser mode are:

- Defaults will not be observed.
- There are no plausibility checks when parameters are being entered.
- There is no check whether the entered parameters are within the limits determined by the laws of physics and technical data.
- The cut-off flow is not active.
- A value for the number of sound paths must be entered.
- Some menu items that are not visible in the normal the normal mode are displayed.

### Attention!

The SuperUser mode is intended for experienced users with advanced application knowledge. The parameters can affect the normal measuring mode and lead to wrong measuring values or to a failure of the measurement when a new measuring point is set up.

### 18.1 Activation/Deactivation

Enter HotCode **071049** immediately after the transmitter has been switched on.

```
SUPERUSER MODE
*IS ACTIVE NOW*
```

It is displayed that the SuperUser mode is activated. Press ENTER. The main menu will be displayed.

The SuperUser mode is deactivated by switching off the transmitter.

### Attention!

Some of the defined parameters are still active after the deactivation of the SuperUser mode.

### 18.2 Transducer Parameters

In the SuperUser mode, the menu item `Transducer Type` will be displayed at the end of the parameter input, even if the transducers are detected by the transmitter.

```
Transducer Type ↑
Q2E-314
```

Press ENTER.

or

```
Transducer Type ↑
Special Version
```

Select `Special Version` to enter the transducer parameters. Press ENTER.

```
Transd. Data      1
    35.99
```

If **Special Version** has been selected, the transducer parameters must be entered.

The transducer parameters must be provided by the transducer manufacturer. Press ENTER after each input.

## 18.3 Defining the Flow Parameters

In the SuperUser mode, it is possible to define some flow parameters (profile bounds, correction of the flow velocity) for the specific application or measuring point.

```
Measuring         ↑
Calibration
```

Select **Special Funct.\SYSTEM settings\Measuring\Calibration**. Press ENTER.

```
Calibrat. data   ↑
for Channel      A:
```

Select the measuring channel for which the flow parameters are to be defined. Press ENTER.

### 18.3.1 Profile Bounds

```
A:Profile bounds
factory          >USER<
```

Select **user** if the profile bounds are to be defined. If **factory** is selected, the default profile bounds will be used and the menu item **Calibration** will be displayed (see section 18.3.2).

Press ENTER.

```
Laminar flow
if R*<          0
```

Enter the max. Reynolds number at which the flow is laminar. The entered number will be rounded to the hundreds. Enter 0 (zero) to use the default value.

range: 0...25 500

default: 1 000

Press ENTER.

```
Turbulent flow
if R*>          0
```

Enter the min. Reynolds number at which the flow is turbulent. The entered number will be rounded to the hundreds. Enter 0 (zero) to use the default value.

range: 0...25 500

default: 3 000

Press ENTER.

```
A:Calibration ?
>OFF<          on
```

A request is displayed if an additional correction of the flow velocity is to be defined. Select `on` to define the correction data, `off` to work without correction of the flow velocity and return to the menu item `SYSTEM settings`.

For the definition of the correction of the flow velocity see section 18.3.2.

example:      profile bound for the laminar flow: 1 500  
               profile bound for the turbulent flow: 2 500

At Reynolds numbers < 1 500, the flow during the measurement is regarded as laminar for the calculation of the physical quantity. At Reynolds numbers > 2 500, the flow is regarded as turbulent. The range 1 500...2 500 is the transition range between laminar and turbulent flow.

<b>Attention!</b>	The defined profile bounds are still active after the deactivation of the SuperUser mode.
-------------------	---

### 18.3.2 Correction of the Flow Velocity

After the profile bounds have been defined (see section 18.3.1), it is possible to define a correction of the flow velocity.

$$v_{\text{cor}} = m \cdot v + n$$

with

- $v$     - measured flow velocity
- $m$     - slope, range: -2.000...+2.000
- $n$     - offset, range: -12.7...+12.7 cm/s
- $v_{\text{cor}}$  - corrected flow velocity

All quantities derived from the flow velocity will be calculated with the corrected flow velocity. The correction data are part of the parameter record and will be transmitted to the PC or printer during the online or offline transmission of data.

<b>Note!</b>	During the measurement, it will not be displayed that the correction of the flow velocity is active.
--------------	--

```
A:Calibration ?
off          >ON<
```

Select `on` to define the correction data, `off` to work without correction of the flow velocity and return to the menu item `SYSTEM settings`.

```
A:Slope=
  1.00
```

If **on** has been selected, enter the slope. If **0.0** is entered, the correction will be deactivated.

range: -2.000...+2.000

Press ENTER.

```
A:Offset=
  0.0      cm/s
```

Enter the offset. Enter **0** (zero) to work without an offset.

range: -12.7...+12.7 cm/s

Press ENTER.

example 1: Slope: 1.1  
Offset: -10.0 cm/s = -0.1 m/s

If a flow velocity  $v = 5$  m/s is measured, before the calculation of the derived quantities, it will be corrected as follows:

$$v_{\text{cor}} = 1.1 \cdot 5 \text{ m/s} - 0.1 \text{ m/s} = 5.4 \text{ m/s}$$

example 2: Slope: -1.0  
Offset: 0.0

Only the sign of the measured values is changed.

#### Note!

The correction data will only be stored when a measurement is started. If the transmitter is switched off without starting a measurement, the entered correction data will be lost.

#### Attention!

The correction of the flow velocity is still active after the deactivation of the SuperUser mode.

## 18.4 Limit of the Signal Amplification

In order to prevent disturbing and/or pipe wall signals (e.g. if the pipe has run empty) from being interpreted as useful signals, it is possible to define a max. signal amplification. If the signal amplification is greater than the max. signal amplification,

- the flow velocity will be marked as invalid. The physical quantity can not be determined.
- the LED of the measuring channel will light red
- a hash symbol "#" will be displayed after the unit of measurement (in case of a normal error, "?" is displayed).

Select **Special Funct./SYSTEM settings/Measuring/Miscellaneous**. Press ENTER until the menu item **Gain threshold** is displayed.

```
A: Gain threshold
Fail if > 90 dB
```

Enter for each measuring channel the max. signal amplification. Enter 0 (zero) if no limit of the signal amplification is to be used.

range: 0...255

Press ENTER.

### Attention!

The limit of the signal amplification is still active after the deactivation of the SuperUser mode.

## 18.5 Upper Limit of the Sound Speed

When the plausibility of the signal is evaluated, it will be checked if the sound speed is within a defined range. The upper limit used for the evaluation is the greater of the following values:

- fixed upper value, default: 1 848 m/s
- value of the sound speed curve of the medium at the operating point plus offset, default offset: 300 m/s

In the SuperUser mode, the values can be defined for media that are not contained in the data set of the transmitter. Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `Bad soundspeed` is displayed.

```
A: Bad soundspeed
thresh. 2007 m/s
```

Enter for each measuring channel the fixed upper limit of the sound speed. Enter 0 (zero) to use the default value.

range: 0...3 000 m/s

default: 1 848 m/s

Press ENTER.

```
A: Bad soundspeed
offset: +321 m/s
```

Enter for each measuring channel the offset. Enter 0 (zero) to use the default value.

range: 0...900 m/s

default: 300 m/s

Press ENTER.

example: fixed upper value of the sound speed `thresh.:` 2 007 m/s  
`offset:` 600 m/s  
 value of the sound speed curve at the operating point: 1 546 m/s

As  $1\,546\text{ m/s} + 600\text{ m/s} = 2\,146\text{ m/s}$  is greater than the fixed upper value 2 007, this value will be used as the upper limit of the sound speed when the plausibility of the signal is evaluated.

GAIN=91dB

SS=1038/2146 m/s

It is possible to display the valid range for the sound speed (SS=) in the lower line during the measurement. The second value (here: 2 146 m/s) is the upper limit at the operating point.

Attention!

The defined upper limit of the sound speed is still active after the de-activation of the SuperUser mode.

18.6 Number of Decimal Places of the Totalizers

The values of the totalizers can be displayed with up to 11 places, e.g. 74890046.03. In the SuperUser mode, it is possible to define the number of decimal places.

Select Special Funct.\SYSTEM settings\Measuring\Miscellaneous. Press ENTER until the menu item Total digits is displayed.

Total digits     ↓

Automatic

Select one of the following list items.  
Automatic: dynamic adjustment  
Fixed to x digit: x decimal places (range: 0...4)  
Press ENTER.

Total digits = Automatic

The number of decimal places will be adjusted dynamically. Low values will first be displayed with 3 decimal places. With greater values, the number of decimal places will be reduced.

max. value	display
< 10 <sup>6</sup>	±0.00 ... ±999999.999
< 10 <sup>7</sup>	±1000000.00 ... ±9999999.99
< 10 <sup>8</sup>	±10000000.0 ... ±99999999.9
< 10 <sup>10</sup>	±1000000000 ... ±9999999999

Total digits = Fixed to x digit

The number of decimal points is constant. The max value of the totalizer is reduced with each additional decimal place.

decimal places	max. value	max. display
0	< 10 <sup>10</sup>	±9999999999
1	< 10 <sup>8</sup>	±99999999.9
2	< 10 <sup>7</sup>	±9999999.99
3	< 10 <sup>6</sup>	±999999.999
4	< 10 <sup>5</sup>	±99999.9999

Note!

The number of decimal places and the max. value defined here only affect the display of the totalizers.

For setting the behavior of the totalizers when the max. value is reached see section 13.2.1.

## 18.7 Manual Reset of the Totalizers

If the manual reset of the totalizers is activated, the totalizers can be reset to zero during the measurement by pressing key C three times.

Select Special Funct.\SYSTEM settings\Measuring\Miscellaneous. Press ENTER until the menu item 3xC clear totals is displayed.

3xC clear totals  
off >ON<

Select on to activate the manual reset of the totalizers, off to deactivate it. Press ENTER.

### Note!

The manual reset of the totalizers is still active after the deactivation of the SuperUser mode.

## 18.8 Display of the Sum of the Totalizers

The sum of the totalizers for the two flow directions can be displayed in the upper line during the measurement.

Select Special Funct.\SYSTEM settings\Measuring\Miscellaneous. Press ENTER until the menu item Show  $\Sigma Q$  is displayed.

Show  $\Sigma Q$   
off >ON<

Select on to activate the display of the sum of the totalizers, off to deactivate it. Press ENTER.

$\Sigma Q$  13.2 m3

If the display of the sum of the totalizers is activated, the sum  $\Sigma Q$  can be displayed in the upper line during the measurement.

## 18.9 Display During the Measurement

In the SuperUser mode, the following information can be displayed during the measurement besides the normal information (see section 12.3):

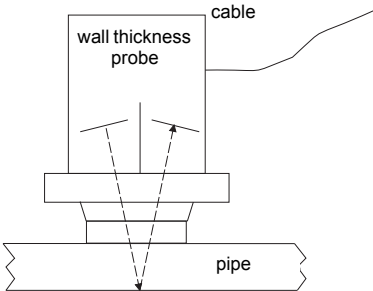
- absolute speed time of the measuring signal
- sound speed
- Reynolds number
- variance of the measuring signal
- range of the sound speed
- signal amplification

# 19 Wall Thickness Measurement (Optional)

If the transmitter has the optional wall thickness measurement, the wall thickness and the longitudinal sound speed of the pipe can be measured. In this case, a wall thickness probe that can be connected directly to the socket of a measuring channel will be included in shipment. The wall thickness probe will be detected automatically when connected to the transmitter. The measured wall thickness can be transmitted directly into the current parameter record.

A modified transit time method is used to determine the wall thickness or the sound speed of the pipe.

- The wall thickness probe emits an ultrasonic pulse which propagates in the pipe.
- The pulse is reflected by the boundary layer of the pipe and received by the wall thickness probe.
- The time difference between emitting and receiving the signal is a measure of the pipe wall thickness (if the sound speed of the material is known) or of the longitudinal sound speed (if the wall thickness is known).



**Fig. 19.1: Measurement principle**

**Note!** With some few exceptions, the transversal sound speed of a material is approx. 30...60 % of the longitudinal sound speed.

## 19.1 Activation of the Wall Thickness Measurement

Connect the wall thickness probe to the measuring channel A or B. The wall thickness measuring mode is activated automatically.

```
*WALL THICKNESS*
*DETECTED ON A:*
```

A message is displayed that the wall thickness probe has been detected.

The main menu of the wall thickness measurement is displayed. The menu structure is similar to the structure of the flow measurement. The program branches are adapted to the wall thickness measurement.

**Note!** The wall thickness measurement mode will be activated as long as the wall thickness probe is connected to the measuring channel.

## 19.2 Parameter Input

### 19.2.1 Parameter Input for the Wall Thickness Measurement

The sound speed of the pipe material has to be entered to measure the wall thickness.

Physic. Quant. ↓  
Wall Thickness

Select **Wall Thickness** in **Output Options\Physic. Quant.** for the measuring channel to which the wall thickness probe is connected.

Pipe Material ↓  
Carbon Steel

Select the pipe material in **Parameter\Pipe Material**. If the material is not in the scroll list, select **Other Material**.

Press **ENTER**.

c-LONGITUDINAL  
5800.0 m/s

A value for the longitudinal sound speed of the selected material is recommended.

If **Other Material** has been selected, 0.0 m/s will be displayed.

Enter the sound speed, if necessary. Press **ENTER**.

**Note!** The measurement can only be started if the entered sound speed is > 0.

Compared to the flow measurement, the sound speed has a great, approximately linear influence on the measuring result. If a sound speed that is 10 % too high is entered, the measured wall thickness will be approx. 10 % greater than the actual wall thickness.

The actual sound speed of a material often differs substantially from the values published in the literature as it depends on the composition, the manufacturing process and the temperature. The sound speeds given in annex C.1 only serve as an orientation.

**Note!** The longitudinal sound speed of a material can be measured precisely using a reference object of known thickness (see section 19.3.2).

### 19.2.2 Parameter Input for the Sound Speed Measurement

The thickness of the pipe must be entered to determine the longitudinal sound speed of a material.

Physic. Quant.    ↑  
c-LONGITUDINAL

Select in Output Options\Physic. Quant. the physical quantity c-LONGITUDINAL for the measuring channel to which the wall thickness probe is connected.

Wall Thickness  
5.12            mm

Select Parameter\Wall Thickness. Enter the pipe wall thickness.

### 19.3 Measurement

par >MEA< opt sf  
Measuring

Select in the main menu the program branch Measuring. Press ENTER.

par >MEA< opt sf  
NO DATA!

This error message will be displayed if the entered parameters are not complete.

#### 19.3.1 Measurement of the Wall Thickness

Wall Thickness  
                  mm?

This display is indicated if the wall thickness has been selected as the physical quantity for the measuring channel connected to the probe.

As long as there is no valid measured value, the unit of measurement and a question mark will be displayed in the lower line.

Wall Thickness    ✓  
3.51            mm

Apply a thin film of the coupling compound to the pipe wall. Press the wall thickness probe against the pipe wall in this position.

As soon as a valid measured value is obtained, it will be displayed in the lower line. A tick will be displayed in the upper line on the right.

The measured value remains on the display when the probe is removed from the pipe.

To minimize errors when measuring the wall thickness, measure the longitudinal sound speed of the material on a reference object of the same material with known dimensions.

- The reference object should be even and smooth.
- The thickness of the reference object should be comparable to the max. thickness of the pipe.

**Note!**

The sound speed of the material depends on the temperature. Therefore, the sound speed of a reference object should be measured at the place where the flow will be measured later to obtain the sound speed at the correct temperature.

**19.3.2 Measurement of the Sound Speed**

c-LONGITUDINAL  
m/s ?

This display will be indicated if the sound speed has been selected as physical quantity for the measuring channel connected to the wall thickness probe.

As long as there is no valid measured value, the unit of measurement and a question mark will be displayed in the lower line.

c-LONGITUDINAL ✓  
5370 m/s

Apply a thin film of the coupling compound to the pipe wall. Press the wall thickness probe against the pipe wall in this position.

As soon as a valid measured value is obtained, it will be displayed in the lower line. A tick will be displayed in the upper line on the right.


The measured value remains on the display when the wall thickness probe is removed from the pipe.

**Note!**

For pipe materials whose longitudinal sound speed can be used for the measurement of the volumetric flow rate see annex C.1.

**19.3.3 Further Information on the Measurement**

SIGNAL IS GOOD  
3.51 mm


Press key  to obtain information on the measuring signal.

This message will be displayed if the measuring signal is sufficient. The LED of the channel will light green.

ERRORSIGNAL #  
mm ?

This message will be displayed if the measuring signal is not sufficient (# = number). The LED of the measuring channel will light red.

Q=■■■■■  
3.51 mm

Press key  again. The bar graph of the signal quality (Q=) will be displayed.

If the signal is not sufficient for a measurement, UNDEF will be displayed. The LED of the measuring channel will light red. Shift the wall thickness probe slightly on the pipe until the LED of the measuring channel lights green.

Wall Thickness
LZ= 186 ns

Press key **3** END to display the transit time of the signal.

### 19.3.4 Errors during the Measurement

If no valid wall thickness can be measured,

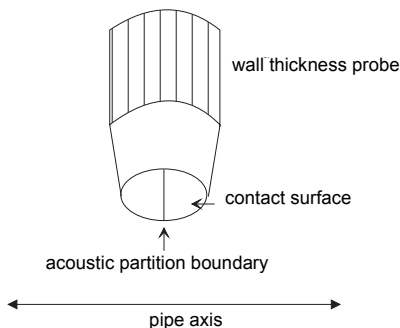
- remove the wall thickness probe from the pipe wall
- clean the wall thickness probe and the position on the pipe where the measurement takes place
- apply a thin film of the coupling compound to the pipe wall
- press the wall thickness probe against the pipe wall in this position
- try measuring again

<b>Note!</b>	Use a small amount of coupling compound. Press the wall thickness probe evenly against the pipe wall.
--------------	---

### 19.3.5 Possible Reasons for Incorrect Measuring Results

- **temperature fluctuations:**  
The sound speed is temperature dependent.
- **doubling effect:**  
When measuring the wall thickness using ultrasonic signals, a phenomenon called the doubling effect can occur if the wall thickness is smaller than the min. measuring range of the probe. The measured value is then twice (or sometimes three times) as high as the actual wall thickness because of repeated reflections of the ultrasonic signal.
- **the measured value is too low:**  
The ultrasonic signal was reflected by a defect and not by the boundary layer, resulting in a shorter transit time and therefore a lower wall thickness.
- **warped surfaces:**  
The probe has to be pressed centrally against the pipe or cylindrical vessel. The applied pressure must be constant. The acoustic partition boundary of the wall thickness probe must be perpendicular to the longitudinal axis of the pipe.
- **surface conditions:**  
Regular unevenness (e.g. small grooves) on the surface of the pipe can result in wrong measured values. Normally, this problem can be avoided by turning the wall thickness probe ins such way that the acoustic partition boundary of the pipe is perpendicular to the orientation of the grooves (see Fig. 19.2).

When measuring on a rough surface, applying too much of the coupling compound can result in wrong measured values. A measurement on a very rough surface might be impossible (message `NO COUPLING` will be displayed). In this case, the surface has to be smoothed.



**Fig. 19.2: Acoustic partition boundary**

### 19.3.6 Storing/Transmission of the Wall Thickness

Press ENTER to stop the measurement and to store or transmit the measured value. The following display appears if a valid wall thickness has been measured and a measured value transmission is activated.

Transfer Data
no >YES<

Select `yes` to store and/or transmit the measured value.

- The wall thickness can be transmitted into the current parameter record.
- The pipe material will be replaced by the material used for the wall thickness measurement.

If the serial transmission of data is activated, the measured value will be transmitted.

### 19.3.7 Stopping the Wall Thickness Measurement

To quit the wall thickness measurement mode, disconnect the wall thickness measurement from the transmitter.

## 20 Inputs

External transducers can be connected to the inputs (optional) to measure the following physical quantities:

- temperature
- density
- pressure
- kinematic viscosity
- dynamic viscosity

The values of the current, voltage, and temperature inputs can be used by all measuring channels.

An input must be assigned to a measuring channel (see section 20.1 and 20.3) and activated (see section 20.4) before it can be used for the measurement and for the storing of measured values.

**Note!**

If a new input module has been installed, the transmitter must be re-started (RESET or off/on) in order for the new inputs to be identified.

SYSTEM settings ↓  
Proc. inputs

Select Special Funct.\SYSTEM settings\Proc. inputs.

Depending on the configuration of the transmitter, one or several of the following list items will be displayed:

Tab. 20.1: List items for Proc. inputs

list item	function
Link temperature	assigning of the temperature inputs to the measuring channels
Link other inp.	assigning of other inputs to the measuring channels
PT100/PT1000	selection of a temperature probe
...go back	return to the precedent menu item

### 20.1 Assigning the Temperature Inputs to the Measuring Channels

#### 20.1.1 Assignment of the Temperature Inputs

SYSTEM settings ↓  
Proc. inputs

Select Special Funct.\SYSTEM settings\ Proc. inputs. Press ENTER.

Proc. inputs ↓  
Link temperature

Select the list item Link temperature.

A:T-Inlet    ↑  
Input T1

Select the temperature input to be assigned to measuring channel A as the supply temperature.

Select the list item `Fixed input val.` if the temperature is to be entered manually before the measurement.

Select the list item `No measuring` if no supply temperature is to be assigned to measuring channel A.

Press ENTER.

Select the list items for `T-Fluid/Outlet`, `T(3)` and `T(4)` of measuring channel A and the other activated channels accordingly. Press ENTER after each input.

**Note!**

The configuration of a measuring channel will be stored when the next channel is selected. The configuration dialog of a channel must be finished to store the changes.

## 20.2 Selection of the Temperature Probe

SYSTEM settings    ↑  
Proc. inputs

Select `Special Funct.\SYSTEM settings\Proc. inputs`. Press ENTER.

Proc. inputs    ↑  
PT100 / PT1000

Select the list item `PT100/PT1000`.

Input T1    ↑  
>PT100<    pt1000

Select the temperature probe.

If necessary, select the temperature probe for `Input T2...T4` accordingly.

## 20.3 Assignment of Other Inputs to the Measuring Channels

SYSTEM settings ↓  
Proc. inputs

Select Special Funct.\SYSTEM settings\Proc. inputs. Press ENTER.

Proc. inputs ↓  
Link other inp.

Select the list item Link other inp..

A:ext.Input(1)  
Input I1

Select the first input to be assigned to measuring channel A. Only the installed inputs are displayed in the scroll list.

Select the list item No measuring if no input is to be assigned to measuring channel A.

Press ENTER.

Select the list items for ext.Input(2)...(4) of measuring channel A and the other activated channels accordingly.

**Note!**

The configuration of a measuring channel will be stored when the next channel is selected. The configuration dialog of a channel has to be finished to store the changes.

## 20.4 Activation of the Inputs

The activation of the inputs in program branch Output Options will only be displayed if the transmitter has inputs of the corresponding type and they have been assigned to a measuring channel.

### 20.4.1 Activation of the Temperature Inputs

Temperature inputs must be activated if the measured temperatures are to be displayed, stored and/or transmitted or if the measured temperature is to be used for the interpolation of the viscosity and the density of the medium.

Temperature T1  
no >YES<

Select in the program branch Output Options the channel for which a temperature input has to be activated.

The temperature inputs assigned to the channel will be displayed one after another. Select yes for the temperature inputs that are to be activated.

**Note!**

The total number of measured values that can be stored will be reduced if a temperature input is activated.

## 20.4.2 Activation of Other Inputs

**Attention!** Observe the correct polarity to avoid damaging the current source. A permanent short circuit can lead to the destruction of the current input.

Inputs must be activated if the measured values are to be displayed, stored and/or transmitted together with the other measured values.

Input	I1
no	>YES<

In the program branch **Output Options**, select the channel for which an input is to be activated.

The inputs assigned to the channel will be displayed one after another. Select **yes** for the inputs that are to be activated.

**Note!** The total number of measured values that can be stored will be reduced if an input is activated.

## 20.5 Temperature Correction

A temperature correction value (offset) can be set for each temperature input. If a correction value has been defined, it will be added automatically to the measured temperature. This function is useful if e.g.:

- the characteristic curves of the two temperature probes differ considerably from each other.
- a known and constant temperature gradient exists between the measured temperature and the actual temperature.

### 20.5.1 Activation/Deactivation of the Temperature Correction

The temperature correction can be activated/deactivated in program branch **Special Funct.\SYSTEM settings\Dialogs/Menus**.

Tx Corr.Offset	
off	>ON<

Select **on** to activate the temperature correction, **off** to deactivate it.

**Note!** If **off** is selected, the temperature correction will be deactivated for all inputs. However, the entered correction values for each temperature input will be stored and displayed again when the temperature correction is activated again.

### 20.5.2 Input of the Temperature Correction

During the flow transducer positioning, the correction values will be requested for each input which has been activated and where the temperature can be measured.

T1 Corr.Offset

0.3
C

Enter the offset for the temperature input.  
Press ENTER.

**Note!**

Only measured temperatures can be corrected.

In order to adjust the zero point, the same reference temperature is measured with the two temperature probes. The difference between the two measured temperatures is entered as the offset for one of the temperature inputs. The difference can also be distributed between the offsets of the two channels.

The display of the temperature difference T1-T2 does not indicate if one or both temperatures are constant or if the values have been corrected.

T1= 90.5 C (COR)

0.0
kW

During the measurement, a corrected temperature value is marked by `cor.`

## 21 Outputs

If the transmitter is equipped with outputs, they have to be installed and activated before they can be used:

- assign a measuring channel (source channel) to the output (if the transmitter has more than one measuring channel)
- assign the physical quantity (source item) to be transmitted to the output by the source channel, and the properties of the signal
- define the behavior of the output in case no valid measured values are available
- activate of the installed output in the program branch `Output Options`

### 21.1 Installation of an Output

All outputs are installed in `Special Funct.\SYSTEM settings\Proc. outputs.`

**Note!**

The configuration of an output will be stored at the end of the dialog. If the dialog is quit by pressing key BRK, the changes will not be stored.

SYSTEM settings ↓  
Proc. outputs

Select `Special Funct.\SYSTEM settings\Proc. outputs.` Press ENTER.

Install Output ↓  
Current I1

Select the output to be installed. Press ENTER.

The scroll list contains all available outputs. A tick ✓ after a list item indicates that this output has already been installed.

I1 enable  
no >YES<

This display will be indicated if the output has not been installed yet. Select `yes`. Press ENTER.

I1 disable  
>NO< yes

If the output has already been installed, select `no` to reconfigure it or `yes` to uninstall the output and to return to the previous menu item to select another output. Press ENTER.

I1 Source chan. ↓  
Channel A:

Select in the scroll list the measuring channel to be assigned to the output as the source channel. Press ENTER.

This display will not be indicated, if the transmitter has only one measuring channel or only one measuring channel is active.

I1 Source item ↑  
Measuring value

Select the physical quantity (source item) to be transmitted from the source channel to the output.

If a binary output is configured, only the list items **Limit** and **Impuls** will be displayed.

The source items and their scroll lists are shown in Tab. 21.1.

**Tab. 21.1: Configuration of the outputs**

source item	list item	output
Measuring value	actual measure Flow	physical quantity selected in the program branch Output Options flow, independently of the physical quantity selected in the program branch Output Options
Quantity	Q+ * actual measure * Flow	totalizer for the positive flow direction totalizer for the physical quantity selected in the program branch Output Options flow totalizer
	Q- * actual measure * Flow	totalizer for the negative flow direction totalizer for the physical quantity selected in the program branch Output Options flow totalizer
	$\Sigma Q$ * actual measure * Flow	sum of the totalizers (positive and negative flow direction) totalizer for the physical quantity selected in the program branch Output Options flow totalizer
Limit	R1 R2 R3	limit message (alarm output R1) limit message (alarm output R2) limit message (alarm output R3)
Temperature	T-Inlet (T1) T-Outlet (T2) T(3)=EINGANG T3 T(4)=INPUT T4 TV(=T1) -TR(=T2)  TV(=T1) -T3 TR(=T2) -T3 TV(=T1) -T4 TR(=T2) -T4 T3-T4	Is only available if a temperature input has been assigned to the channel. supply temperature return temperature further temperature input further temperature input difference between supply and return temperature  difference between supply temperature and T(3) difference between return temperature and T(3) difference between supply temperature and T(4) difference between return temperature and T(4) difference between T(3) and T(4)
Impuls	from abs(x) from x > 0 from x < 0	pulse without sign consideration pulse for positive measured values pulse for negative measured values
Miscellaneous	c-Medium Signal	sound speed of the medium signal amplitude of a measuring channel

### 21.1.1 Output Range

I1 Output range ↓  
 4/20 mA

I1 Output MIN ↓  
 10.0 mA

I1 Output MAX ↓  
 11.0 mA

I1 Output MAX ↓  
 12.0 MINIMAL

When configuring an analog output, the output range will be defined now. Select a list item or `other range...` to enter the output range manually.

If `other range...` has been selected, enter the values Output MIN and Output MAX. Press ENTER after each input.

This error message will be displayed if the output range is not min. 10 % of the max. output range. The next possible value will be displayed. Repeat the input.

example:  $I_{MAX} - I_{MIN} \geq 2 \text{ mA}$  for a 4...20 mA current output

### 21.1.2 Error Output

In the following dialog, an error value can be defined which is to be output if the source item can not be measured e.g. if there are solids in the medium.

**Tab. 21.2: Error output**

error value	result
Minimum	output of the lower limit of the output range
Hold last value	output of the last measured value
Maximum	output of the upper limit of the output range
Other value...	The value must be entered manually. It must be within the limits of the output.

example:      source item: volumetric flow rate  
                 output: current output  
                 output range: 4...20 mA  
                 error value delay  $t_d$  (see section 21.2): > 0

The volumetric flow rate can not be measured during the time interval  $t_0...t_1$  (see Fig. 21.1). The error value will be output.

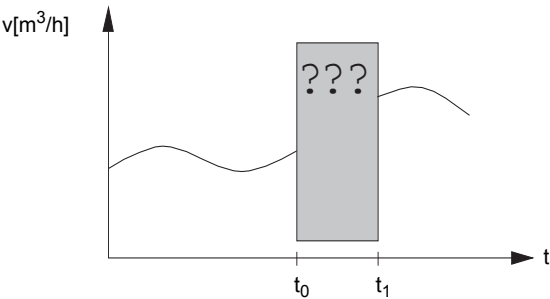
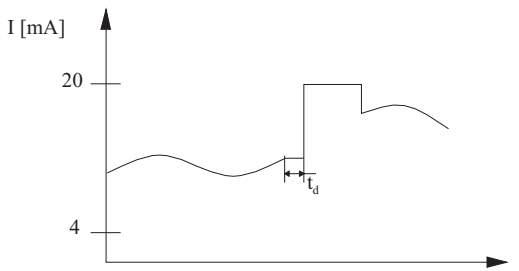
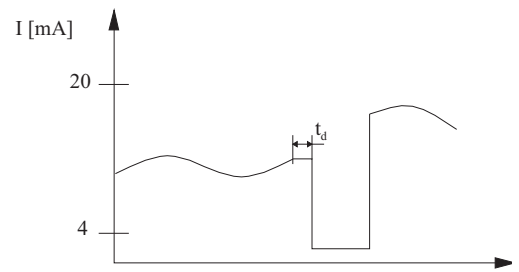


Fig. 21.1: Error output

Tab. 21.3: Examples for the error output

list item for the error output	output signal
<div>Error-value ↓ Minimum (4.0mA)</div>	
<div>Error-value ↓ Hold last value</div>	

Tab. 21.3: Examples for the error output

list item for the error output	output signal
<div>Error-value      ↓ Maximum (20.0mA)</div>	
<div>Error-value      ↓ Other value...</div> <div>error output = 2 mA</div>	

Error-value      ↓  
Minimum (4.0mA)

Select a list item for the error output. Press ENTER.

Error-value      ↓  
3.5                  mA

If Other value has been selected, enter an error value.  
It has to be within the limits of the output.  
Press ENTER.

Note!                      The settings will be stored at the end of the dialog.

21.1.3 Function Test

The function of the installed output can now be tested. Connect a multimeter to the installed output.

Test of the Analog Outputs

I1:Output Test  
4                      mA

The current output is tested in the display. Enter a test value. It has to be within the output range. Press ENTER.

```
I1=    4.0 mA
Again? no    >YES<
```

If the multimeter displays the entered value, the output functions correctly.

Select **yes** to repeat the test, **no** to return to **SYSTEM** settings. Press **ENTER**.

### Test of the Binary Outputs

```
B1:Output Test ↓
Reed-Relay OFF
```

Select **Reed-Relay OFF** or **Open collect OFF** in the scroll list **Output Test** to test the de-energized state of the output. Press **ENTER**. Measure the resistance at the output. The value has to be high ohmic.

Select **yes**. Press **ENTER**.

```
B1=OFF
AGAIN? no    >YES<
```

```
B1:Output Test ↓
Reed-Relay ON
```

Select **Reed-Relay ON** or **Open collect**. **ON** in the scroll list **Output Test** to test the energized state of the output. Press **ENTER**. Measure the resistance at the output. The value has to be low ohmic.

Select **yes** to repeat the test, **no** to return to **SYSTEM** settings. Press **ENTER**.

```
B1=ON
AGAIN? no    >YES<
```

## 21.2 Error Value Delay

The error value delay is the time interval after which the error value will be transmitted to the output in case no valid measured values are available. The error value delay can be entered in the program branch **Output Options** if this menu item has been previously activated in the program branch **Special Funct..** If the error value delay is not entered, the damping factor will be used.

```
Error-val. delay
>DAMPING<    edit
```

Select **Special Funct.\SYSTEM settings\Dialogs/Menus/Error-val. delay**.

Select **Damping** if the damping factor is to be used as the error value delay. Select **Edit** to activate the menu item **Error-val. delay** in the program branch **Output Options**.

```
Error-val. delay
      10      s
```

From now on, the error value delay can be entered in the program branch **Output Options**.

## 21.3 Activation of an Analog Output

**Note!** An output can only be activated in the program branch `Output Options` if it has been previously installed.

```
Output Options  ↓
for Channel    A:
```

In the program branch `Output Options`, select the channel for which an output is to be activated. Press `ENTER`.

This display will not be indicated, if the transmitter has only one measuring channel.

```
Current Loop
I1: no      >YES<
```

Press `ENTER` until `Current Loop` is displayed. Select `yes` to activate the output. Press `ENTER`.

### 21.3.1 Measuring Range of the Analog Outputs

After an analog output has been activated in the program branch `Output Options`, the measuring range of the source item must be entered.

```
Meas.Values
>ABSOLUT<      sign
```

Select `sign` if the sign of the measured values is to be considered for the output.

Select `absolut` if the sign is not to be considered.

```
Zero-Scale Val.
0.00      m3/h
```

Enter the lowest expected measured value. The unit of measurement of the source item will be displayed.

`Zero-Scale Val.` is the measured value that corresponds to the lower limit of the output range as defined in section 21.1.1.

```
Full-Scale Val.
300.00     m3/h
```

Enter the highest expected measured value.

`Full-Scale Val.` is the measured value that corresponds to the upper limit of the output range as defined in section 21.1.1.

example:      output: current output  
              output range: 4...20 mA  
              Zero-Scale Val.: 0 m<sup>3</sup>/h  
              Full-Scale Val.: 300 m<sup>3</sup>/h  
              volumetric flow rate = 0 m<sup>3</sup>/h, corresponds to 4 mA  
              volumetric flow rate = 300 m<sup>3</sup>/h, corresponds to 20 mA

### 21.3.2 Function Test

The function of the installed output can now be tested. Connect a multimeter to the installed output.

```
I1: Test output ?
no          >YES<
```

Select `yes` to activate the output. Press ENTER.

```
I1: Test value =
5.00      m3/h
```

Enter a test value. The value must be indicated on the connected multimeter. Press ENTER.

```
I1: Test output ?
no          >YES<
```

Select `yes` to repeat the test. Press ENTER.

## 21.4 Configuration of a Frequency Output as a Pulse Output

A frequency output sends a signal with a frequency that depends on the volume flow rate. The frequency output can be configured in such way that the source item can be totaled by using each period of the output signal as the increment.

### Installation of a Frequency Output (Optional)

```
Install Output ↑
Frequency F1
```

Select Frequency F1 in Special Funct.\SYSTEM settings\Proc. outputs. Press ENTER.

```
F1 enable
no          >YES<
```

Select `yes` if the output has not been installed. Press ENTER.

or

```
F1 disable
>NO<          yes
```

Select `no` if the output has already been installed. Press ENTER.

```
F1 Source chan.↑
Channel A:
```

Select in the scroll list the measuring channel to be assigned to the output as the source channel. Press ENTER.

```
F1 Source item ↑
Measuring value
```

Select in the scroll list `Measuring value` (but not `Impuls!`). Press ENTER.

```
Setup as pulse ?
no          >YES<
```

If `Measuring value` has been selected and the source item can be totaled, a request will be indicated whether the frequency output is to be configured as a pulse output. Select `yes`. Press ENTER.

```
F1 Output MAX
      1.0      kHz
```

Enter the upper limit of the frequency. Press ENTER.

The lower limit of the frequency and the error value will be set automatically to 0.5 Hz.

### Activation of the output

```
Output Options ↓
for Channel  A:
```

In the program branch `Output Options`, select the channel for which the input is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

```
Frequency Output
F1: no      >YES<
```

Select `yes` to activate the output. Press ENTER.

```
Pulses per unit:
      1000     /m3
```

Enter the number of pulses that is to be assigned to the unit of measurement of the totalizer. Press ENTER.

Example: 1000 pulses correspond to 1 m<sup>3</sup> of the totalized medium.

```
INFO: max flow=
      3600.0    m3/h
```

The max. flow depending on the upper limit of the frequency and pulse value is indicated. Press ENTER.

## 21.5 Activation of a Binary Output as a Pulse Output

A pulse output is an integrating output which emits a pulse when the volume or the mass of the medium which has passed the measuring point reaches a given value (`Pulse Value`). The integrated quantity is the selected physical quantity. Integration is restarted as soon as a pulse is emitted.

### Note!

The menu item `Pulse Output` will only be indicated in the program branch `Output Options` if a pulse output has been installed.

```
Output Options ↓
for Channel  A:
```

Select in the program branch `Output Options` the channel for which a pulse output is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

```
Pulse Output
B1: no      >YES<
```

Select `yes` to activate the output. Press ENTER.

Pulse Output  
NO COUNTING !

This error message will be displayed if the flow velocity has been selected as the physical quantity.

The use of the pulse output is not possible in this case because integrating the flow velocity does not result in a reasonable value.

Pulse Value  
0.01 m3

Enter the pulse value. The unit of measurement will be displayed according to the current physical quantity.

When the totalized physical quantity reaches the pulse value, a pulse will be emitted.

Pulse Width  
100 ms

Enter the pulse width.

The range of possible pulse widths depends on the specification of the instrument (e.g. counter, PLC) that is to be connected to the output.

The max. flow that the pulse output can work with will be displayed now. This value is calculated on the basis of the entered pulse value and pulse width.

If the flow exceeds this value, the pulse output will not function properly. In this case, the pulse value and the pulse width must be adapted to the flow conditions. Press ENTER.

## 21.6 Activation of a Binary Output as an Alarm Output

**Note!** The menu item `Alarm Output` will only be displayed in the program branch `Output Options` if an alarm output has been installed.

Max. 3 alarm outputs R1, R2, R3 per channel operating independently of each other can be configured. The alarm outputs can be used to output information on the current measurement or to start and stop pumps, motors, etc.

### 21.6.1 Alarm Properties

The switching condition, the holding behavior and the switching function of an alarm output can be defined.

**Tab. 21.4: Alarm properties**

alarm property	setting	description
func (switching condition)	MAX	The alarm will switch if the measured value exceeds the upper limit.
	MIN	The alarm will switch if the measured value falls below the lower limit.
	+→- -→+	The alarm will switch if the flow direction changes (sign change of measured value).
	QUANT.	The alarm will switch if totalizing is activated and the totalizer reaches the limit.
	ERROR	The alarm will switch if a measurement is not possible.
	OFF	The alarm is switched off.
typ (holding behavior)	NON-HOLD	If the switching condition is not true anymore, the alarm will return to the idle state after approx. 1 s.
	HOLD	The alarm remains activated even if the switching condition is not true anymore.
mode (switching function)	NO Cont.	The alarm is energized if the switching condition is true and de-energized if idle.
	NC Cont.	The alarm is de-energized if the switching condition is true and energized if idle.

**Note!**

If no measurement is made, all alarms will be de-energized, independently of the programmed switching function.

Output Options ↓  
for Channel A:

Select in the program branch `Output Options` the channel for which an alarm output is to be activated. Press **ENTER**.

This display will not be indicated if the transmitter has only one measuring channel.

Alarm Output  
no >YES<

Select `yes` to activate the alarm output. Press **ENTER**.

R1=FUNC<typ mode  
Function: MAX

Three scroll lists will be displayed:

- func: switching condition
- typ: holding behavior
- mode: switching function

Press key **4** and **6** to select a scroll list in the upper line. Press key **8** and **2** to select a list item in the lower line.

Press **ENTER** to store the settings.

## 21.6.2 Setting the Limits

If the switching condition **MAX** or **MIN** has been selected in the scroll list **func**, the limit of the output will have to be defined:

R1 Input:	↑
act. Volume flow	

Select in the scroll list **Input** the physical quantity to be used for the comparison. The following list items are available:

- selected physical quantity
- signal amplitude
- sound speed of the medium

Press ENTER.

High Limit:	
-10.00	m <sup>3</sup> /h

switching condition: **MAX**

Enter the upper limit. Press ENTER.

The alarm will switch if the measured value exceeds the limit.

Low Limit:	
-10.00	m <sup>3</sup> /h

switching condition: **MIN**

Enter the lower limit. Press ENTER.

The alarm will switch if the measured value falls below the limit.

**example 1:** High Limit:: -10 m<sup>3</sup>/h  
 volumetric flow rate = -9.9 m<sup>3</sup>/h  
 the limit is exceeded, the alarm switches  
 volumetric flow rate = -11 m<sup>3</sup>/h  
 the limit is not exceeded, the alarm does not switch

**example 2:** Low Limit:: -10 m<sup>3</sup>/h  
 volumetric flow rate = -11 m<sup>3</sup>/h  
 the measured value is below the limit, the alarm switches  
 volumetric flow rate = -9.9 m<sup>3</sup>/h  
 the measured value is not below the limit, the alarm does not switch

If the switching condition **QUANT.** has been selected in the scroll list **func**, the limit of the output will have to be defined:

Quantity Limit:	
1.00	m <sup>3</sup>

switching condition: **QUANT.**

Enter the limit of the totalizer. Press ENTER.

The alarm will switch if the measured value reaches the limit.

A positive limit will be compared to the totalizer value for the positive flow direction.

A negative limit will be compared to the totalizer value for the negative flow direction.

The comparison will also take place if the totalizer of the other flow direction is displayed.

**Note!**

The unit of measurement of the limit corresponds to the unit of measurement of the selected physical quantity.

If the unit of measurement of the physical quantity is changed, the limit has to be converted and entered again.

example 1: physical quantity: volumetric flow rate in  $\text{m}^3/\text{h}$   
Quantity Limit::  $1 \text{ m}^3$

example 2: physical quantity: volumetric flow rate in  $\text{m}^3/\text{h}$   
Low Limit::  $60 \text{ m}^3/\text{h}$

The unit of measurement of the physical quantity is changed to  $\text{m}^3/\text{min}$ .  
The new limit to be entered is  $1 \text{ m}^3/\text{min}$ .

### 21.6.3 Defining the Hysteresis

A hysteresis can be defined for the alarm output R1 to prevent a constant triggering of the alarm due to small fluctuations of the measured values around the limit.

The hysteresis is a symmetrical range around the limit. The alarm will be activated if the measured values exceed the upper limit and deactivated if the measured values fall below the lower limit.

example: High Limit::  $30 \text{ m}^3/\text{h}$   
Hysteresis:  $1 \text{ m}^3/\text{h}$

The alarm will be triggered at values  $> 30.5 \text{ m}^3/\text{h}$  and deactivated at values  $< 29.5 \text{ m}^3/\text{h}$ .

R1 Hysteresis:  
1.00  $\text{m}^3/\text{h}$

switching condition: MIN or MAX

Enter the value for Hysteresis.

or

Enter 0 (zero) to work without a hysteresis.

Press ENTER.

## 21.7 Behavior of the Alarm Outputs

### 21.7.1 Apparent Switching Delay

Measured values and totalizer values will be displayed rounded to two decimal places. The limits, however, will be compared to the non-rounded measured values. This might cause an apparent switching delay when the measured value changes marginally (less than two decimal places). In this case, the switching accuracy of the output is greater than the accuracy of the display.

### 21.7.2 Reset and Initialization of the Alarms

After a cold start, all alarm outputs will be initialized as follows:

**Tab. 21.5: Alarm state after a cold start**

func	OFF
typ	NON-HOLD
mode	NO Cont.
Limit	0.00

Press key C three times during the measurement to set all alarm outputs to the idle state. Alarm outputs whose switching condition is still met will be activated again after 1 s. This function is used to reset alarm outputs of the type `HOLD` if the switching condition is not met anymore.

By pressing key BRK, the measurement will be stopped and the main menu selected. All alarm outputs will be de-energized, independently of the programmed idle state.

### 21.7.3 Alarm Outputs during Transducer Positioning

At the beginning of the transducer positioning (bar graph display), all alarm outputs switch back to the programmed idle state.

If the bar graph is selected during measurement, all alarm outputs will switch back to the programmed idle state.

An alarm output of the type `HOLD` that has been activated during the previous measurement will remain in the idle state after the transducer positioning if the switching condition is not met anymore.

Switching of the alarms into the idle state will not be displayed.

### 21.7.4 Alarm Outputs during Measurement

An alarm output with switching condition `MAX` or `MIN` will be updated max. once per second to avoid humming (i.e. fluctuation of the measured values around the value of the switching condition).

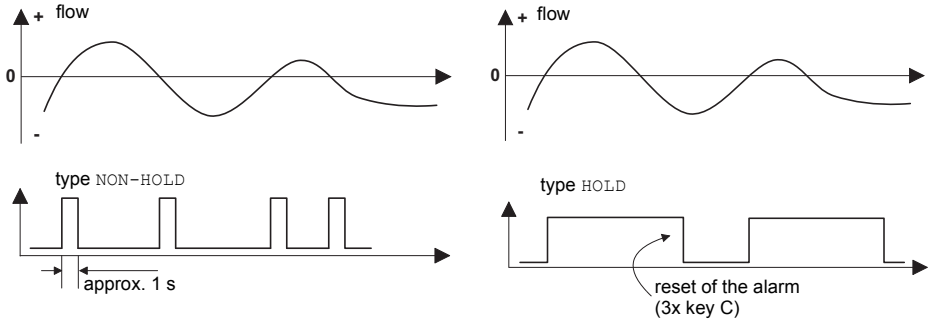
An alarm output of the type `NON-HOLD` will be activated if the switching condition is met. It will be deactivated if the switching condition is not met anymore. The alarm will remain activated min. 1 s even if the switching condition is met for a shorter period of time.

Alarm outputs with the switching condition `QUANT.` will be activated if the limit is reached.

Alarm outputs with the switching condition **ERROR** will only be activated after several unsuccessful measuring attempts. Therefore, typical short-term disturbances of the measurement (e.g. switching on of a pump) will not activate the alarm.

Alarm outputs with the switching condition **+→- -→+** and of the type **NON-HOLD** will be activated with each change of the flow direction for approx. 1 s (see Fig. 21.2).

Alarm outputs with the switching condition **+→- -→+** and of the type **HOLD** will be active after the first change of the flow direction. They can be switched back by pressing key C three times (see Fig. 21.2).



**Fig. 21.2: Behavior of a relay when the flow direction changes**

If there is an internal adaptation to changing measuring conditions, e.g. to a considerable rise of the medium temperature, the alarm will not switch. Alarm outputs with the switching condition **OFF** will be set automatically to the switching function **NO Cont..**

### 21.7.5 Alarm State Indication

**Note!** There is no visual or acoustic indication of alarm output switching.



The alarm state can be displayed during the measurement. This function is activated in **Special Funct.\SYSTEM settings\Dialogs/Menus**.

SHOW RELAIS STAT  
off >ON<


















Select the menu item **SHOW RELAIS STAT**. Select **on** to activate the alarm state indication.

Scroll during the measurement with key **[F9]** until the alarm state is displayed in the upper line.

RX =    , with  being a pictogram as shown in Tab. 21.6.

example: R1 =    

Tab. 21.6: Pictograms for the alarm state indication

	no.	func (switching condition)	typ (holding behavior)	mode (switching function)	current state
R		= 			
	1	 OFF	 NON-HOLD	 NO Cont.	 closed
	2	 MAX	 HOLD	 NC Cont.	 open
	3	 MIN			
		 +→- -→+			
		 QUANT.			
		 ERROR			

21.8 Deactivation of the Outputs

If the programmed outputs are no longer required, they can be deactivated. The configuration of a deactivated output is stored and will be available if the output is activated again.

Alarm Output

>NO<yes

Select no in Output Options\Alarm Output to deactivate an output. Press ENTER.

## 22 Troubleshooting

If any problem appears which can not be solved with the help of this manual, contact our sales office and give a precise description of the problem. Specify the type, the serial number and the firmware version of the transmitter.

### Calibration

FLUXUS is a very reliable instrument. It is manufactured under strict quality control, using modern production techniques. If installed as recommended in an appropriate location, used cautiously and taken care of conscientiously, no troubles should appear. The transmitter has been calibrated at the factory and, usually, a re-calibration of the transmitter will not be necessary. A re-calibration is recommended if

- the contact surface of the transducers shows visible wear or
- the transducers were used for a prolonged period of time at a high temperature (several months  $>130\text{ }^{\circ}\text{C}$  for normal transducers or  $> 200\text{ }^{\circ}\text{C}$  for high temperature transducers).

The transmitter has to be sent to FLEXIM for recalibration under reference conditions.

### The display does not work at all or fails regularly

Check if the battery is inserted and charged. Connect the power supply. If the power supply is ok, the transducers or an internal component of the transmitter are defective. The transducers and the transmitter have to be sent to FLEXIM for repair.

### The message **SYSTEM ERROR** is displayed

Press key BRK to return to the main menu.

If this message is displayed repeatedly, write down the number in the lower line. Track down the situations when the error is displayed. Contact FLEXIM.

### The backlight of the display does not work, but all other functions are available.

The backlight is defective. This problem does not affect the other functions of the display. Send the transmitter to FLEXIM for repair.

### Date and time are wrong, the measured values are deleted when the transmitter is switched off

The data backup battery has to be replaced. Send the transmitter to FLEXIM.

**An output does not work**

Make sure that the outputs are configured correctly. Check the function of the output as described in section 21.1.3. If the output is defective, contact FLEXIM.

**A measurement is impossible or the measured values substantially differ from the expected values**

see section 22.1.

**The values of the totalizer are wrong**

see section 22.6.

**22.1 Problems with the Measurement****A measurement is impossible because no signal is received. A question mark is displayed in the lower line on the right**

- Check if the entered parameters are correct, especially the outer pipe diameter, the pipe wall thickness and the sound speed of the medium. (Typical errors: The circumference or the radius was entered instead of the diameter. The inner pipe diameter was entered instead of the outer pipe diameter.)
- Make sure that the recommended transducer distance was adjusted when mounting the transducers.
- Make sure that an appropriate measuring point has been selected (see section 22.2).
- Try to establish better acoustic contact between the pipe and the transducers (see section 22.3).
- Enter a lower value for the number of sound paths. The signal attenuation might be too high due to a high medium viscosity or deposits on the inner pipe wall (see section 22.4).

**The measuring signal is received but no measured values can be obtained**

- An exclamation mark "!" in the lower line on the right indicates that the defined upper limit of the flow velocity is exceeded and, therefore, the measured values are marked as invalid. The limit must be adapted to the measuring conditions or the check must be deactivated (see section 13.3).
- If no exclamation mark "!" is displayed, a measurement at the selected measuring point is not possible.

**Loss of signal during the measurement**

- If the pipe had been pressureless: Was there no measuring signal afterwards? Contact FLEXIM.
- Wait briefly until acoustic contact is reestablished. The measurement can be interrupted by a temporarily higher proportion of liquid and solids in the medium.

**The measured values substantially differ from the expected values**

- Wrong measured values are often caused by wrong parameters. Make sure that the entered parameters are correct for the measuring point.
- If the parameters are correct, see section 22.5 for the description of typical situations in which wrong measured values are obtained.

**22.2 Selection of the Measuring Point**

- Make sure that the recommended min. distance to any disturbance source is observed (see chapter 5, Tab. 5.2).
- Avoid measuring points with deposit formation in the pipe.
- Avoid measuring points in the vicinity of deformations and defects on the pipe and in the vicinity of welds.
- Measure the temperature at the measuring point and make sure that the transducers are suitable for this temperature.
- Make sure that the outer pipe diameter is within the measuring range of the transducers.
- When measuring on a horizontal pipe, the transducers must be mounted on the side of the pipes.
- 

**22.3 Maximum Acoustic Contact**

Observe the instructions in chapter 8.

**22.4 Application Specific Problems****The entered sound speed of the medium is wrong**

The entered sound speed is used to calculate the transducer distance and is therefore very important for the transducer positioning. The sound speeds stored in the transmitter only serve as orientation.

**The entered pipe roughness is not appropriate**

Check the entered value. The state of the pipe should be taken into account.

**Measurements on porous pipe materials (e.g. concrete or cast iron) are only possible under certain conditions**

Contact FLEXIM.

**The pipe lining may cause problems during the measurement if it is not firmly attached to the inner pipe wall or consists of an acoustically absorbing material**

Try measuring on a liner free section of the pipe.

**A higher proportion of droplets or solids in the medium scatter and absorb the ultrasonic signal and therefore attenuate the measuring signal**

A measurement is impossible if the value is  $\geq 10\%$ . If the proportion is high, but  $< 10\%$ , a measurement is only possible under certain conditions.

## **22.5 Large Deviations of the Measured Values**

**The entered sound speed of the medium is wrong**

A wrong sound speed can result in the ultrasonic signal that is reflected directly on the pipe wall being mistaken for the measuring signal that has passed through the medium. The flow calculated on the basis of the wrong signal by the transmitter is very small or fluctuates around zero.

**The defined upper limit of the flow velocity is too low**

All measured flow velocities that are greater than the upper limit will be ignored and marked as invalid. All quantities derived from the flow velocity will also be marked as invalid. If several correct measured values are ignored, the totalizer values will be too low.

**The entered cut-off flow is too high**

All flow velocities below the cut-off flow are set to zero. All derived quantities are also set to zero. The cut-off flow (default: 2.5 cm/s) has to be set to a low value in order to be able to measure at low flow velocities.

**The entered pipe roughness is not appropriate****The flow velocity of the medium is outside the measuring range of the transmitter****The measuring point is not appropriate**

Select another measuring point to check whether the results are better. Because pipes are never rotationally symmetric, the flow profile is affected. Change the transducer position according to the pipe deformation.

**The operating volumetric flow rate meets the expectations, but the standard volumetric flow rate deviates strongly**

The parameters for the measurement of the standard volumetric flow rate have not been entered correctly (see section 17.4).

## 22.6 Problems with the Totalizers

### **The values of the totalizer are too high**

See `Special Function\SYSTEM settings\Measuring\Quantity recall`. If this menu item is activated, the values of the totalizer will be stored. The totalizer will continue with this value at the start of the next measurement.

### **The values of the totalizer are too low**

One of the totalizers has reached the upper limit and has to be reset to zero manually.

### **The sum of the totalizers is not correct**

See `Special Function\SYSTEM settings\Measuring\Quant. wrapping`. The sum of both totalizers (throughput) transmitted via an output is not valid after the overflow (wrapping) of one of the totalizers.

## 22.7 Data Transmission

### **The file with the transmitted measuring data contains meaningless strings**

The transmission parameters of the transmitter and the transmission program are not identical. Adjust the transmission parameters of the transmitter (see section 14.2.4) and of the program `FluxData` (see section 14.2.7) or of the terminal program.

A Menu Structure

	cold start resistant
<b>Program Branch Parameter</b>	
<div>&gt;PAR&lt; mea opt sf Parameter</div>	main menu: selection of the program branch Parameter
<div>Parameter           ↓ for Channel        A:</div>	selection of a measuring channel (A, B) or of a calculation channel (Y, Z)  This display will not be indicated if the transmit- ter has only one measuring channel.
<div>Parameter from: ↓ Par.Record        01</div>	selection of a parameter record  This display will only be indicated if at least one parameter record has been defined.
<div>Edit Parameters &gt;NO&lt;               yes</div>	selection if the the parameters of the parameter record are to be edited
<b>When a Measuring Channel is Selected (A, B)</b>	
<div>Outer Diameter 100.0           mm</div>	input of the outer pipe diameter
<div>Pipe Circumfer. 314.2           mm</div>	input of the pipe circumference  This display will only be indicated if Special Funct.\SYSTEM settings\Dialogs/ Menus\Pipe Circumfer. is activated and Outer Diameter = 0 has been entered.
<div>Wall Thickness 3.0             mm</div>	input of the pipe wall thickness  range: depends on the connected transducers default: 3 mm
<div>Pipe Material     ↓ Carbon Steel</div>	selection of the pipe material

		cold start resistant
<div>c-Material 3230.0 m/s</div>	<p>input of the sound speed of the pipe material range: 600...6553.5 m/s</p> <p>This display will only be indicated if Other Material has been selected.</p>	
<div>Lining no &gt;YES&lt;</div>	<p>selection whether the pipe is lined</p>	
<div>Lining Bitumen ↑</div>	<p>selection of the lining material</p> <p>This display will only be indicated if Lining = yes has been selected.</p>	
<div>c-Material 3200.0 m/s</div>	<p>input of the sound speed of the lining material range: 600...6553.5 m/s</p> <p>This display will only be indicated if Other Material has been selected.</p>	
<div>Liner Thickness 3.0 mm</div>	<p>input of the liner thickness default: 3 mm</p>	
<div>Roughness 0.4 mm</div>	<p>input of the roughness of the inner pipe wall range: 0...5 mm default: 0.1 mm (for steel as pipe material)</p>	
<div>Medium Natural gas user ↑</div>	<p>selection of the medium</p>	
<div>c-Medium MIN 1400.0 m/s</div>	<p>input of the min. sound speed of the medium range: 200...3500 m/s</p> <p>This display will only be indicated if Other Medium has been selected.</p>	

		cold start resistant
<div><div>c-Medium</div><div>1550.0</div><div>MAX</div><div>m/s</div></div>	<p>input of the max. sound speed of the medium</p> <p>This display will only be indicated if Other Medium has been selected.</p>	
<div><div>Kinem.Viscosity</div><div>1.00</div><div>mm2/s</div></div>	<p>input of the kinematic viscosity of the medium</p> <p>range: 0.01...30 000 mm<sup>2</sup>/s</p> <p>This display will only be indicated if Other Medium or Natural gas user has been selected.</p>	
<div><div>Density</div><div>60.00</div><div>kg/m3</div></div>	<p>input of the operating density of the medium</p> <p>range: 0.1...20 000 kg/m<sup>3</sup> if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is activated or 0.01...20 g/cm<sup>3</sup>, if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is deactivated</p> <p>This display will only be indicated if Other Medium or Natural gas user has been selected.</p>	
<div><div>Gas compr.factor</div><div>1.000</div><div>factor</div></div>	<p>input of the gas compressibility factor</p> <p>range: 0.001...2</p> <p>This display will only be indicated if Other Medium or Natural gas user has been selected.</p>	
<div><div>Medium Temperat.</div><div>20.0</div><div>C</div></div>	<p>input of the medium temperature</p> <p>default: 20 °C</p>	
<div><div>Fluid pressure</div><div>60.00</div><div>bar</div></div>	<p>input of the medium pressure</p> <p>range: 1...600 bar</p> <p>This display will only be indicated if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is activated or if Gas-Measuring is deactivated and Special Funct.\SYSTEM settings\Dialogs/Menus\Fluid pressure is activated.</p>	

	cold start resistant
<div>Transducer Type ↑ Standard</div>	<p>selection of the transducer type</p> <p>This display will only be indicated if no or special transducers are connected.</p>
<p><b>When a Calculation Channel is Selected (Y, Z)</b></p> <p>Calculation channels will only be available if the transmitter has more than one measuring channel.</p>	
<div>Calculation: Y= A - B</div>	display of the current calculation function
<div>&gt;CH1&lt; funct ch2 ↑ A - B</div>	selection of the calculation function
<p><b>Program Branch Measuring</b></p>	
<div>par &gt;MEA&lt; opt sf Measuring</div>	main menu: selection of the program branch Measuring
<div>CHANN: &gt;A&lt; B Y Z MEASUR ✓ ✓ - .</div>	<p>activation of the channels</p> <p>This display will not be indicated if the transmitter has only one measuring channel.</p>
<div>A:Meas.Point No.: xxx (↑↓←→)</div>	<p>input of the measuring point number</p> <p>This display will only be indicated if Output Options\Store Meas.Data and/or Serial Output are activated.</p>
<div>A:PROFILE CORR. &gt;NO&lt; yes</div>	<p>activation/deactivation of the flow profile correction</p> <p>This display will only be indicated if Special Funct.\SYSTEM settings\Measuring\Flow Velocity = uncorr. has been selected.</p>
<div>A: Sound Path 2 NUM</div>	<p>input of the number of sound paths</p> <p>This display will only be indicated if Special Funct.\SYSTEM settings\Dialogs\Menus\Sound Path = USER has been selected.</p>

		cold start resistant
<div>Transd. Distance A:54 mm Reflex</div>	<p>display of the transducer distance to be adjusted between the inner edges of the transducers</p> <p>This display will only be indicated if in Special Funct.\SYSTEM settings\Dialogs/ Menus\Sound Path = user has been selected.</p>	
<div>S=■■■■■ A:■&lt;&gt;■=54 mm!</div>	<p>bar graph S=, display of the amplitude of the received signal</p>	
<b>Program Branch Output Options</b>		
<div>par mea &gt;OPT&lt; sf Output Options</div>	<p>main menu: selection of the program branch Output Options</p>	
<div>Output Options ↓ for Channel A:</div>	<p>selection of the channel whose output options are to be defined</p>	
<div>Physic. Quant. ↓ act. Volume flow</div>	<p>selection of the physical quantity</p>	
<div>Volume in: ↓ m3/h</div>	<p>selection of the unit of measurement for the physical quantity</p>	
<div>Temperature T1 no &gt;YES&lt;</div>	<p>activation of a temperature input</p> <p>This display will only be indicated if the temperature input T1 has been assigned to the channel in Special Funct.\SYSTEM settings\ Proc. inputs\Link temperature.</p>	
<div>INPUT I1 no &gt;YES&lt;</div>	<p>activation of a current input for an external temperature measurement</p> <p>This display will only be indicated if the input I1 has been assigned to the channel in Special Funct.\SYSTEM settings\ Proc. inputs\Link other inp..</p>	

		cold start resistant
<div>Damping 10 s</div>	<p>input of the duration over which a floating average of the measured values has to be determined</p> <p>range: 1...100 s</p>	
<div>Store Meas.Data no &gt;YES&lt;</div>	<p>activation of the data logger</p>	
<div>Serial Output no &gt;YES&lt;</div>	<p>activation of the measured value transmission to a PC or a printer via the serial interface</p>	
<div>Storage Rate     ↑ Once per 10 sec.</div>	<p>selection of the storage rate for storing measured values in the data logger</p> <p>This display will only be indicated if Output Options\Store Meas.Data and/or Serial Output are activated.</p>	
<div>Storage Rate 1 s</div>	<p>Input of the storage rate if Storage Rate = EXTRA has been selected</p> <p>range: 1...43 200 s (= 12 h)</p>	
<b>Current Loop</b>		
<div>Current Loop I1: no &gt;YES&lt;</div>	<p>activation of a current output</p> <p>This display will only be indicated if the current output has been installed in Special Funct.\SYSTEM settings\Proc. outputs.</p>	
<div>Meas.Values &gt;ABSOLUT&lt;     sign</div>	<p>selection whether the sign of the measured values is to be considered for the output</p> <p>This display will only be indicated if Current Loop is activated.</p>	
<div>Zero-Scale Val. 0.00 m3/h</div>	<p>input of the lowest/highest measured value to be expected for the current output</p> <p>The values are assigned to the lower/upper limit of the output range.</p>	
<div>Full-Scale Val. 300.00 m3/h</div>	<p>These displays will only be indicated if Current Loop is activated.</p>	

		cold start resistant
<div>Error-val. delay 10s</div>	<p>input of the error value delay, i.e. of the time interval after which the value entered for the error output will be transmitted to the output if no valid measured values are available</p> <p>This display will only be indicated if Special Funct.\SYSTEM settings\Dialogs/Menus\Error-val. delay = EDIT has been selected.</p>	
<b>Pulse Output</b>		
<div>Pulse Output B1: no &gt;YES&lt;</div>	<p>Activation of a Pulse Output</p> <p>This display will only be indicated if a pulse output has been installed in Special Funct.\SYSTEM settings\Dialogs/Menus\Proc. outputs.</p>	
<div>Pulse Value 0.01m3</div>	<p>input of the pulse value (value of the totalizer at which a pulse will be emitted)</p> <p>This display will only be indicated if Pulse Output is activated.</p>	
<div>Pulse Width 100ms</div>	<p>input of the pulse width</p> <p>range: 1...1000 ms</p> <p>This display will only be indicated if Pulse Output is activated.</p>	
<b>Alarm Output</b>		
<div>Alarm Output no &gt;YES&lt;</div>	<p>activation of an alarm output</p> <p>This display will only be indicated if an alarm output has been installed in Special Funct.\SYSTEM settings\Proc. outputs.</p>	
<div>R1=FUNC&lt;typ mode Function: MAX</div>	<p>Selection of the switching condition (func), the holding behavior (typ) and the switching function (mode) of the alarm output.</p> <p>This display will only be indicated if Alarm Output is activated.</p>	

	cold start resistant
<div>R1 Input: ↑ act. Volume flow</div>	<p>selection of the physical quantity to be monitored</p> <p>This display will only be indicated for R1 if Alarm Output is activated.</p>
<div>High Limit: -10.00 m3/h</div>	<p>input of the upper limit of the physical quantity to be monitored</p> <p>This display will only be indicated if Alarm Output has been activated and MAX has been selected as the switching condition.</p>
<div>Low Limit: -10.00 m3/h</div>	<p>input of the lower limit of the physical quantity to be monitored</p> <p>This display will only be indicated if Alarm Output has been activated and MIN has been selected as the switching condition.</p>
<div>Quantity Limit: 1.00 m3</div>	<p>input of the limit for the totalizer of the physical quantity to be monitored</p> <p>This display will only be indicated if Alarm Output has been activated and QUANT. has been selected as the switching condition.</p>
<div>R1 Hysteresis: 1.00 m3/h</div>	<p>input of the hysteresis for the lower or upper limit</p> <p>This display will only be indicated if Alarm Output has been activated and MIN or MAX has been selected as the switching condition.</p>
<b>Program Branch Special Funct.</b>	
<div>par mea opt &gt;SF&lt; Special Funct.</div>	<p>main menu: selection of the program branch Special Funct.</p>
<b>SYSTEM settings</b>	
<div>Special Funct. ↑ SYSTEM settings</div>	<p>selection of Special Funct.\SYSTEM settings</p>

	cold start resistant
<b>SYSTEM settings\Set Clock</b>	
<div>SYSTEM settings ↓ Set Clock</div>	selection of the displays for the input of the date and the time
<b>SYSTEM settings\Libraries</b>	
<div>SYSTEM settings ↓ Libraries</div>	selection of the displays for the management of the material and medium scroll lists
<b>SYSTEM settings\Libraries\Material list</b>	
<div>Libraries ↓ Material list</div>	selection of the displays for the arrangement of the material scroll list (pipe and lining materials)
<b>SYSTEM settings\Libraries\Medium list</b>	
<div>Libraries ↓ Medium list</div>	selection of the displays for the arrangement of the medium scroll list
<b>SYSTEM settings\Libraries\Format USER-AREA</b>	
<div>Libraries ↓ Format USER-AREA</div>	selection of the displays for the partitioning of the coefficient memory for the storing of user defined material and medium properties
<div>Format USER-AREA Materials: 03</div>	input of the number of user defined materials
<div>Format USER-AREA Media: 03</div>	input of the number of user defined media
<div>USER AREA: 52% used</div>	display of the occupancy of the coefficient memory

		cold start resistant
<div>Format NOW? no &gt;YES&lt;</div>	confirmation of the selected partition	
<div>FORMATTING ... ■■■■■■ ...</div>	the coefficient memory is being partitioned	
<b>SYSTEM settings\Libraries\Extended Library</b>		
<div>Libraries ↑ Extended Library</div>	selection of the displays for the activation of the extended library	
<div>Extended Library off &gt;ON&lt;</div>	activation of the extended library	
<b>SYSTEM settings\Dialogs/Menus</b>		
<div>SYSTEM settings ↑ Dialogs/Menus</div>	selection of the displays for the activation/deactivation or setting of the menu items in the other program branches	
<div>Pipe Circumfer. off &gt;ON&lt;</div>	activation of the menu item for the input of the pipe circumference in the program branch Parameter	x
<div>Fluid pressure off &gt;ON&lt;</div>	activation of the menu item for the input of the medium pressure in the program branch Parameter  This display will only be indicated if SYSTEM settings\Measuring\Gas-Measuring is deactivated.	
<div>Meas.Point No.: (1234) &gt;(↑↓← →)&lt;</div>	selection of the input mode for the measuring point number in the program branch Measuring:  (1234): digits, point, hyphen (↑↓← →): ASCII editor	

		cold start resistant
<div>Sound Path auto &gt;USER&lt;</div>	<p>setting of the display for the input of the sound path in the program branch <i>Measuring</i>:</p> <ul style="list-style-type: none"><li>• <i>user</i>: a value for the number of sound paths will be recommended. This value can be changed.</li><li>• <i>auto</i>: selection of reflection mode or diagonal mode.</li></ul> <p>recommended setting: <i>user</i></p>	
<div>Transd. Distance auto &gt;USER&lt;</div>	<p>setting for the display for the input of the transducer distance in the program branch <i>Measuring</i>:</p> <ul style="list-style-type: none"><li>• <i>user</i>: only the entered transducer distance will be displayed if the recommended and the entered transducer distances are identical</li><li>• <i>auto</i>: only the recommended transducer distance will be displayed</li></ul> <p>recommended setting: <i>user</i></p>	
<div>Tx Corr.Offset off &gt;ON&lt;</div>	<p>activation of the menu item for the input of a correction value (offset) for each temperature input in the program branch <i>Measuring</i></p>	
<div>Error-val. delay damping &gt;EDIT&lt;</div>	<p>selection of the error value delay</p> <ul style="list-style-type: none"><li>• <i>damping</i>: The damping factor will be used.</li><li>• <i>edit</i>: The menu item for the input of the error value delay in the program branch <i>Output Options</i> will be activated.</li></ul>	x
<div>SHOW RELAIS STAT off &gt;ON&lt;</div>	<p>activation of the display of the alarm state during the measurement</p>	x
<b>SYSTEM settings\Proc. inputs</b>		
<div>SYSTEM settings ↓ Proc. inputs</div>	<p>selection of the displays for the setting of the inputs of the transmitter</p>	

		cold start resistant
<div>Proc. inputs    ↑ Link temperature</div>	<p>assignment of temperature inputs and other inputs to the measuring channels</p>	
<b>SYSTEM settings\Measuring</b>		
<div>SYSTEM settings ↓ Measuring</div>	<p>selection of the displays for the settings of the measurement</p>	
<div>Gas-Measuring off                    &gt;ON&lt;</div>	<p>activation of the gas measurement default: on</p>	
<div>Compare c-fluid no                    &gt;YES&lt;</div>	<p>activation of the display for the difference between the measured and the expected sound speed of a selected reference medium during the measurement</p>	
<div>Flow Velocity normal &gt;UNCORR.&lt;</div>	<p>selection whether the flow velocity is displayed and transmitted with or without profile correction</p>	x
<div>Cut-off Flow absolut            &gt;SIGN&lt;</div>	<p>selection of the input of a lower limit for the flow velocity:</p> <ul style="list-style-type: none"> <li>absolut: independent of the flow direction</li> <li>sign: dependent on the flow direction</li> </ul>	x
<div>Cut-off Flow factory            &gt;USER&lt;</div>	<p>activation of the input of a lower limit of the flow velocity:</p> <ul style="list-style-type: none"> <li>factory: the default limit of 2.5 cm/s will be used</li> <li>user: input of a limit</li> </ul>	
<div>+Cut-off Flow 2.5                cm/s</div>	<p>input of the cut-off flow for positive measured values</p> <p>range: 0...12.7 cm/s (0.127 m/s), default: 2.5 cm/s (0.025 m/s)</p> <p>This display will only be indicated if Cut-off Flow = sign and Cut-off Flow = user has been selected.</p>	

		cold start resistant
<div>-Cut-off Flow -2.5 cm/s</div>	<p>Input of the cut-off flow for negative measured values</p> <p>range: -12.7...0 cm/s</p> <p>default: -2.5 cm/s</p> <p>This display will only be indicated if Cut-off Flow = sign und Cut-off Flow = user has been selected.</p>	
<div>Cut-off Flow 2.5 cm/s</div>	<p>Input of the cut-off flow for the absolute value of the measured values</p> <p>range: 0...12.7 cm/s</p> <p>default: 2.5 cm/s</p> <p>This display will only be indicated if Cut-off Flow = absolut und Cut-off Flow = user has been selected.</p>	
<div>Velocity limit 0.0 m/s</div>	<p>input of an upper limit of the flow velocity</p> <p>range: 0.1...25.5 m/s</p> <p>All measured values that are greater than the limit will be marked as outliers.</p> <p>Input of 0 (zero) switches off the detection for outliers.</p>	x
<div>Quant. wrapping off &gt;ON&lt;</div>	<p>activation of the overflow of the totalizers</p>	x
<div>Quantity recall off &gt;ON&lt;</div>	<p>activation of the taking-over of the totalizer values after a restart of the measurement</p>	x
<b>SYSTEM settings\Gas-Measuring</b>		
<div>SYSTEM settings ↑ Gas-Measuring</div>	<p>selection of the displays for the input of the standard conditions for the gas measurement</p> <p>This display will only be indicated if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is activated.</p>	

		cold start resistant
<div>Normal pressure 1.01325 bar</div>	input of the pressure for the local standard conditions range: 0.70001...1.30000 bar	
<div>Normal temper. 0.0 C</div>	input of the temperature for the local standard conditions range: -20.0...+90.0 °C	
<b>SYSTEM settings\Proc. outputs</b>		
<div>SYSTEM settings ↓ Proc. outputs</div>	selection of the displays for the setting of the outputs of the transmitter	
<div>Install Output ↓ Current I1</div>	selection of the output to be installed	
<b>SYSTEM settings\Storing</b>		
<div>SYSTEM settings ↓ Storing</div>	selection of the displays for the storing of measured values in the data logger	
<div>Ringbuffer off &gt;ON&lt;</div>	setting of the overflow behavior of the data logger	x
<div>Storage mode sample &gt;AVERAGE&lt;</div>	selection of the sample mode <ul style="list-style-type: none"> <li>sample: storing and online transmission of the displayed measured value</li> <li>average: storing and online transmission of the average of all measured values of a storage interval</li> </ul>	x
<div>Quantity Storage one &gt;BOTH&lt;</div>	setting of the storing behavior of the totalizers <ul style="list-style-type: none"> <li>one: the value of the totalizer that is currently displayed will be stored</li> <li>both: one value for each flow direction will be stored</li> </ul>	x

		cold start resistant
<div>Store Amplitude off &gt;ON&lt;</div>	activation of the storing of the signal amplitude The value will only be stored if the data logger is activated.	x
<div>Store c-Medium off &gt;ON&lt;</div>	activation of the storing of the sound speed of the medium The value will only be stored if the data logger is activated.	x
<div>Beep on storage &gt;ON&lt; off</div>	activation of an acoustic signal every time a measured value is stored or transmitted	x
<b>SYSTEM settings\serial transmis.</b>		
<div>SYSTEM settings ↓ serial transmis.</div>	selection of the displays for the formatting of the serial transmission of measured values	
<div>SER:kill spaces off &gt;ON&lt;</div>	activation of the serial transmission of data with/without blanks	
<div>SER:decimalpoint '.' &gt;'.'&lt;</div>	selection of the decimal marker for floating point numbers	
<div>SER:col-separat. ';' &gt;'TAB'&lt;</div>	selection of the character for column separation	
<b>SYSTEM settings\Miscellaneous</b>		
<div>SYSTEM settings ↓ Miscellaneous</div>	selection of the display for the setting of the contrast	
<div>SETUP DISPLAY ← CONTRAST →</div>	setting of the contrast of the display	

		cold start resistant
<b>Instrum. Inform.</b>		
<div>Special Funct. ↑ Instrum. Inform.</div>	selection of the displays for information about the transmitter	
<div>G60X-XXXXXXX Free: 18327</div>	display of the type, serial number and max. available data logger memory	
<div>G60X-XXXXXXX V x.xx dd.mm.yy</div>	display of the type, serial number and firmware version with the date (dd - day, mm - month, yy - year)	
<b>STORE CURR.REC.</b>		
<div>Special Funct. ↑ Store Curr.Rec.</div>	<p>selection of the displays for the storing of a parameter record</p> <p>This menu item can only be selected if the parameters have been entered in the program branch <i>Parameter</i>.</p>	
<div>Store Par. To: ↑ Par.Record 01</div>	selection of the number for a parameter record	
<div>Overwrite no &gt;YES&lt;</div>	<p>confirmation of overwriting of an existing parameter record</p> <p>This display will only be indicated if the selected number already contains a parameter record.</p>	
<b>Delete Para.Rec.</b>		
<div>Special Funct. ↑ Delete Para.Rec.</div>	selection of the displays for the deleting of a parameter record	
<div>Delete: ↑ Par.Record 01</div>	<p>selection of the number of the parameter record to be deleted</p> <p>This display will only be indicated if a parameter set already exists.</p>	

	cold start resistant
<div>Really Delete? no &gt;YES&lt;</div> <p><b>Print Meas.Val.</b></p> <div>Special Funct. ↓ Print Meas.Val.</div> <div>Send Header 01 .....</div> <div>■■■■■ .....</div> <p><b>Delete Meas.Val.</b></p> <div>Special Funct. ↓ Delete Meas.Val.</div> <div>Really Delete? no &gt;YES&lt;</div> <p><b>Battery status</b></p> <div>Special Funct. ↓ Battery status</div> <div>■■■■■ ?73%- RELEARN! Cy: 24</div> <div>■■■ 30%- Cy: 1</div>	<p>confirmation for the deleting of a parameter record</p> <p>selection of the displays for the transmission of stored measured values to a PC</p> <p>start of the transmission of measured values This display will only be indicated if the data logger contains measured values and the transmitter is connected to a PC via a serial cable.</p> <p>display of the data transmission progress</p> <p>selection of the displays for the deleting of stored measured values</p> <p>confirmation for the deleting of measured values This display will only be indicated if measured values are stored in the data logger.</p> <p>selection of the displays for the charging of the battery</p> <p>display of the charge state of the battery If RELEARN is displayed, a relearn cycle is recommended.</p> <p>display of the charge state of the battery</p>

		cold start resistant
<div>POWER OFF IN 10 s</div>	message that the transmitter will be switched off soon	
<div>■ LOW BATTERY WHILE POWER OFF</div>	message when the transmitter is switched on that the transmitter had been switched off automatically due to a low charge state	
<div>LOW BATTERY !</div>	message that the battery is almost empty	
<b>Install Material</b>		
<div>Special Funct. ↓ Install Material</div>	selection of the displays for the input of the pipe and lining materials	
<b>Install Material with Special Funct.\SYSTEM settings\ Libraries\Extended Library = off</b>		
<div>Install Material &gt;EDIT&lt; delete</div>	selection whether a user defined material is to be edited or deleted	
<div>USER Material ↓ #01:--not used--</div>	selection of a user defined material	
<div>EDIT TEXT (↑↓←→) USER MATERIAL 1</div>	input of a designation for the selected material	
<div>c-Material 1590.0 m/s</div>	input of the sound speed of the material range: 600...6553.5 m/s	
<div>Roughness 0.4 mm</div>	input of the roughness of the material	

	cold start resistant
<b>Install Material with Special Funct.\SYSTEM settings\ Libraries\Extended Library = on</b>	
<div>Edit Material    ↑ Basics:Y=m*X +n</div>	selection of the function for the temperature and pressure dependency of the material properties
<div>USER Material    ↑ #01:--not used--</div>	selection of a user defined material
<div>USER Material    2 &gt;EDIT&lt;        delete</div>	selection whether the user defined material is to be edited or deleted  This display will only be indicated if the selected material already exists.
<div>#2: Input Name: USER MATERIAL    2</div>	input of a designation for the selected material
<div>T-SOUNDSP. 1500.0            m/s</div>	input of the constants for the transversal sound speed of the material  The number of constants depends on the function selected above.
<div>L-SOUNDSP. 1500.0            m/s</div>	input of the constants for the longitudinal sound speed of the material  The number of constants depends on the function selected above.
<div>Default soundsp. long.    &gt;TRANS.&lt;</div>	selection of the sound wave type for the flow measurement
<div>Roughness 0.4                mm</div>	input of the roughness of the material
<div>Save changes no                &gt;YES&lt;</div>	confirmation that the changes are to be stored  This display will only be indicated if a new material has been entered or the properties of an existing material have been changed.

	cold start resistant
<b>Install Medium</b>	
<div>Special Funct.   ↑ Install Medium</div>	selection of the displays for the input of media
<b>Install Medium with Special Funct.\SYSTEM settings\ Libraries\Extended Library = off</b>	
<div>Install Medium &gt;EDIT&lt;       delete</div>	selection whether a user defined medium is to be edited or deleted
<div>USER Medium       ↑ #01:--not used--</div>	selection of a user defined medium
<div>EDIT TEXT (↑↓← →) USER MEDIUM       1</div>	input of a designation for the selected medium
<div>c-Medium           MIN 1400.0           m/s</div>	input of the min. sound speed of the medium range: 800...3500 m/s
<div>c-Medium           MAX 1550.0           m/s</div>	input of the max. sound speed of the medium
<div>Kinem.Viscosity 1.01       mm<sup>2</sup>/s</div>	input of the kinematic viscosity of the medium range: 0.01...30 000.00 mm <sup>2</sup> /s
<div>Density 60.00       kg/m<sup>3</sup></div>	input of the operating density of the medium
<b>Install Medium with Special Funct.\SYSTEM settings\ Libraries\Extended Library = on</b>	
<div>Edit Medium       ↑ Basics:Y=m*X +n</div>	selection of the function for the temperature and pressure dependency of the medium properties

		cold start resistant
<div>USER Medium     ↓ #01:--not used--</div>	selection of a user defined medium	
<div>USER MEDIUM     2 &gt;EDIT&lt;     delete</div>	selection whether the user defined medium is to be edited or deleted  This display will only be indicated if the selected medium already exists.	
<div>#2: Input Name: USER MEDIUM     2</div>	input of a designation for the selected medium	
<div>SOUNDSPEED 1500.0     m/s</div>	input of the constants for the longitudinal sound speed of the medium  The number of constants depends on the function selected above.	
<div>VISCOSITY 1.0     mm2/s</div>	input of the kinematic viscosity of the medium	
<div>DENSITY 1.0     g/cm3</div>	input of the operating density of the medium	
<div>GASFACTOR 0.0</div>	input of the gas compressibility factor	
<div>Save changes no     &gt;YES&lt;</div>	confirmation that the changes are to be stored  This display will only be indicated if a new medium has been entered or the properties of an existing medium have been changed.	
After the input of HotCode 071001		x
<div>DNmin Q-Sensor 15     mm</div>	input of the lower limit of the inner pipe diameter for the displayed transducer type  range: 3...63 mm	

## B Technical Data

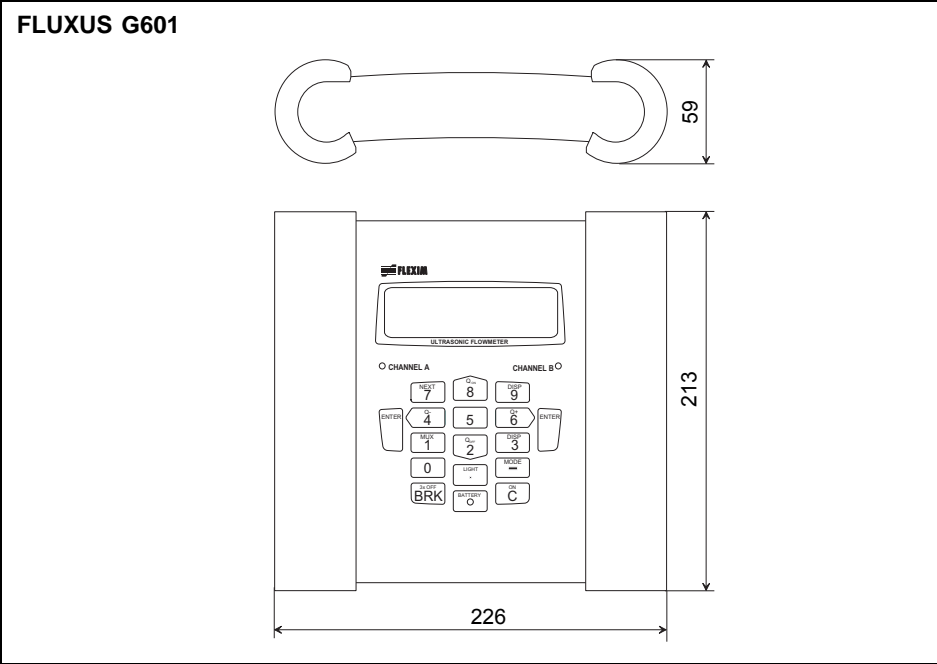
### Flow Transmitter FLUXUS G601

<b>FLUXUS</b>	<b>G601</b>
design	portable
<b>measurement</b>	
measuring principle	transit time difference correlation principle
flow velocity	0.01...35 m/s, pipe diameter dependent
repeatability	0.15 % of reading $\pm 0.01$ m/s
medium	gases with a ratio of the characteristic acoustic impedances of pipe wall and gas < 3000, e.g. nitrogen, air, oxygen, hydrogen, argon, helium, ethylene, propane
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5M-1985
<b>accuracy</b>	
- volumetric flow rate	$\pm 1...3$ % of reading $\pm 0.01$ m/s depending on application $\pm 0.5$ % of reading $\pm 0.01$ m/s with field calibration
<b>flow transmitter</b>	
power supply	100...240 V/50...60 Hz (power supply), 10.5...15 V DC (socket at transmitter ) or integrated battery
battery	Li-Ion, 7.2 V/4.5 Ah operating time (without outputs, inputs and backlight): > 14 h
power consumption	< 6 W
number of flow measuring channels	2
signal damping	0...100 s, adjustable
measuring cycle (1 channel)	100...1000 Hz
response time	1 s (1 channel), optional: 70 ms
housing material	PA, TPE, AutoTex, stainless steel
degree of protection according to EN 60529	IP 65
weight	1.9 kg
fixation	QuickFix pipe mounting fixture
operating temperature	-10...+60 °C
display	2 x 16 characters, dot matrix, backlit
menu language	English, German, French, Dutch, Spanish
<b>measuring functions</b>	
physical quantities	operational volumetric flow rate, standard volumetric flow rate, mass flow rate, flow velocity
totalizers	volume, mass
calculation functions	average, difference, sum
diagnostic functions	sound velocity, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times

FLUXUS	G601
<b>data logger</b>	
loggable values	all physical quantities, totaled values and diagnostic values
capacity	> 100 000 measured values
<b>communication</b>	
interface	RS232/USB
<b>serial data kit</b>	
software (all Windows <sup>TM</sup> versions)	<ul style="list-style-type: none"> <li>- FluxData: download of measured data, graphical presentation, conversion to other formats (e.g. for Excel<sup>TM</sup>)</li> <li>- FluxKoef: creating medium data sets</li> </ul>
cable	RS232
adapter	RS232 - USB
<b>transport case</b>	
dimensions	500 x 400 x 190 mm
<b>outputs</b>	
	The outputs are galvanically isolated from the transmitter.
number	max. on request
accessories	output adapter (if number of outputs > 4)
<b>current output</b>	
range	0/4...20 mA
accuracy	0.1 % of reading $\pm 15 \mu\text{A}$
active output	$R_{\text{ext}} < 200 \Omega$
passive output	$U_{\text{ext}} = 4...16 \text{ V}$ , dependent on $R_{\text{ext}}$ $R_{\text{ext}} < 500 \Omega$
<b>frequency output</b>	
range	0...5 kHz
open collector	24 V/4 mA
<b>binary output</b>	
optorelay	26 V/100 mA
binary output as alarm output	limit, change of flow direction or error
- functions	
binary output as pulse output	0.01...1000 units 1...1000 ms
- pulse value	
- pulse width	

FLUXUS	G601
<b>inputs</b>	
	The inputs are galvanically isolated from the transmitter.
number	max. 4
accessories	input adapter (if number of inputs > 2)
<b>temperature input</b>	
designation	Pt100/Pt1000
connection	4-wire
range	-150...+560 °C
resolution	0.01 K
accuracy	±0.01 % of reading ±0.03 K
<b>current input</b>	
accuracy	0.1 % of reading ±10 µA
passive input	$R_i = 50\ \Omega$ , $P_i < 0.3\ \text{W}$
- range	-20...+20 mA
<b>voltage input</b>	
range	0...1 V
accuracy	0.1 % of reading ±1 mV
internal resistance	$R_i = 1\ \text{M}\Omega$

Dimensions



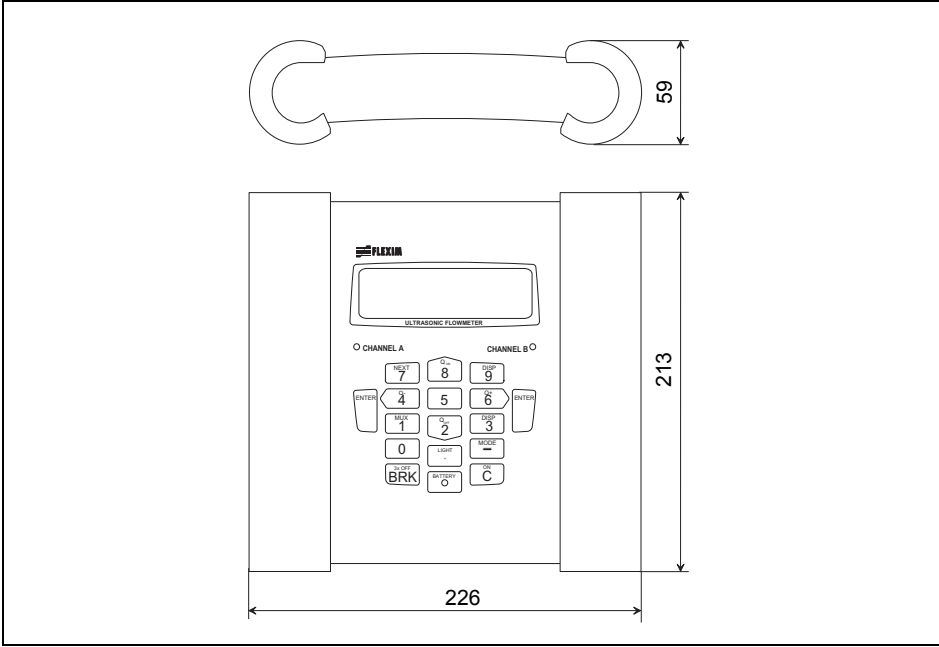
in mm

## Flow Transmitter FLUXUS G608

FLUXUS	G608**-A2
design	portable, ATEX zone 2
<b>measurement</b>	
measurement principle	transit time difference correlation principle
flow velocity	0.01...35 m/s, depending on pipe diameter
repeatability	0.15 % of reading $\pm 0.01$ m/s
medium	all acoustically conductive gases, e.g. nitrogen, air, oxygen, hydrogen, argon, helium, ethylene, propane
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5M-1985
<b>accuracy</b>	
- volumetric flow rate	$\pm 1...3$ % of reading $\pm 0.01$ m/s depending on application $\pm 0.5$ % of reading $\pm 0.01$ m/s with field calibration
<b>flow transmitter</b>	
power supply	100...240 V/50...60 Hz (power supply unit, outside of explosive atmosphere), 10.5...15 V DC (socket at transmitter, with power adapter (optional)), $U_m = 16$ V, integrated battery
battery	Li-Ion, 7.2 V/4.5 Ah operating time (without outputs, inputs and backlight): > 14 h
power consumption	< 6 W
number of flow measuring channels	2
signal attenuation	0...100 s, adjustable
measuring cycle (1 channel)	100...1000 Hz
response time	1 s (1 channel), option: 70 ms
housing material	PA, TPS, PC, Polyester, stainless steel
degree of protection according to IEC/EN 60529	IP65
dimensions	see dimensional drawing
weight	1.9 kg
fixation	QuickFix pipe mounting fixture
operating temperature	-10...+60 °C
display	2 x 16 characters, dot matrix, backlight
menu language	English, German, French, Dutch, Spanish

FLUXUS		G608**-A2	
explosion protection			
A T E X	category	gas: 3G	dust: 2D
	EPL	Gc	Db
	zone	2	21
	marking	CE 0637 Ex II3G Ex nA nC ic IIC (T6)T4 Gc II2D Ex tb IIIC T 100 °C Db T <sub>a</sub> -10...+(50)60 °C	
	certification	IBExU10ATEX1067	
	type of protection	gas: non sparking dust: protection by enclosure temperature inputs: intrinsic safety	
measuring functions			
physical quantities		operating volumetric flow rate, standard volumetric flow rate, mass flow rate, flow velocity	
totalizer		volume, mass	
calculation functions		average, difference, sum	
diagnostic functions		sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times	
data logger			
loggable values		all physical quantities, totaled values and diagnostic values	
capacity		> 100 000 measured values	
communication			
interface		RS232/USB	
serial data kit			
software (all Windows™ versions)		- FluxData: download of measurement data, graphical presentation, conversion to other formats (e.g. for Excel™) - FluxKoef: creating medium data sets	
cable		RS232	
adapter		RS232 - USB	
transport case			
dimensions		500 x 400 x 190 mm	
outputs			
		The outputs are galvanically isolated from the transmitter.	
accessories		output adapter (optional)	
current output			
range		0/4...20 mA	
accuracy		0.1 % of reading ±15 µA	
passive output		U <sub>ext</sub> = 4...9 V, depending on R <sub>ext</sub> R <sub>ext</sub> < 200 Ω	
binary output			
optorelay		26 V/100 mA	
binary output as alarm output			
- functions		limit, change of flow direction or error	
binary output as pulse output			
- pulse value		0.01...1000 units	
- pulse width		1...1000 ms	

Dimensions

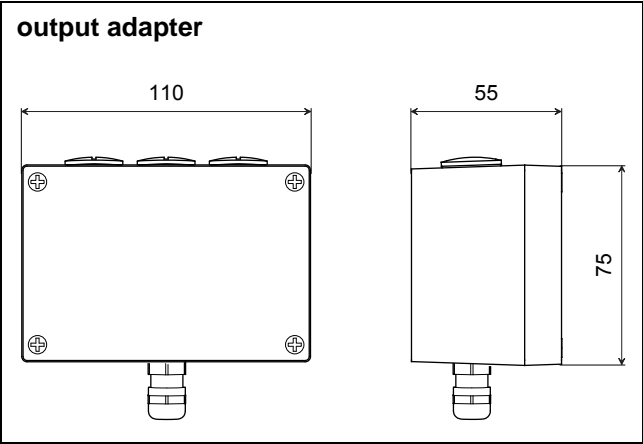


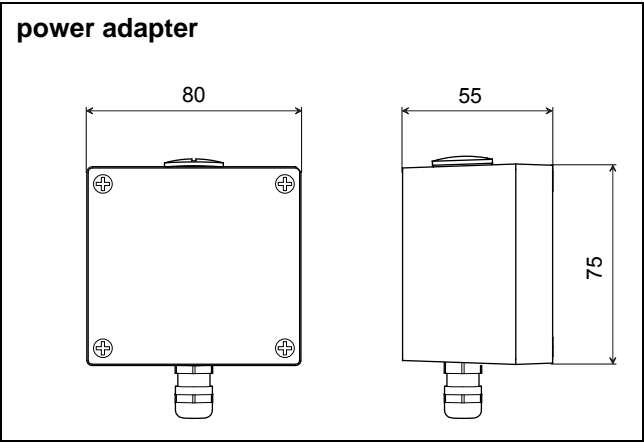
in mm

Adapters (optional)

		output adapter	power adapter
technical type		OA608A2	PA608A2
dimensions		see dimensional drawing	
weight	kg	0.36	0.29
material			
housing		polyester	
gasket		silicone	
degree of protection according to IEC/ EN 60529		IP66	
operating temperature			
min.	°C	-20	
max.	°C	+90	
explosion protection			
ATEX	zone		2
	marking		CE Ex II 3G Ex nA II T6 Gc Ta -20...+60 °C
	type of protection		non sparking

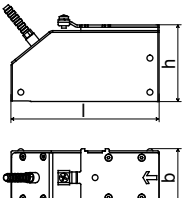
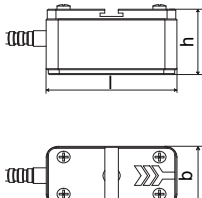
Dimensions





in mm

## Shear Wave Transducers

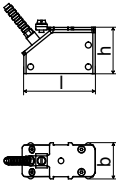
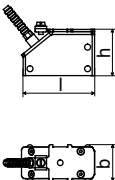
technical type		GDG1NZ7	GDK1NZ7	GDM1NZ7	GDP1NZ7
order code		GSG-NNNNL	GSK-NNNNL	GSM-NNNNL	GSP-NNNNL
transducer frequency	MHz	0.2	0.5	1	2
medium pressure <sup>1</sup>					
min. extended min.	bar bar	metal pipe: 20 metal pipe: 30 plastic pipe: 1	metal pipe: 20 metal pipe: 30 plastic pipe: 1	metal pipe: 20 metal pipe: 30 plastic pipe: 1	metal pipe: 20 metal pipe: 30 plastic pipe: 1
inner pipe diameter d <sup>2</sup>					
min. extended	mm	250	70	30	15
min. recommended	mm	380	80	40	20
max. recommended	mm	810	500	80	40
max. extended	mm	1100	720	120	60
pipe wall thickness					
min.	mm	14	5	2.5	1.5
max.	mm	-	-	-	-
material					
housing		PEEK with stainless steel cap 304 (1.4301)	PEEK with stainless steel cap 304 (1.4301)	stainless steel 304 (1.4301)	stainless steel 304 (1.4301)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection according to EN 60529		IP 67	IP 67	IP 67	IP 67
transducer cable					
type		1699	1699	1699	1699
length	m	5	5	4	4
dimensions					
length l	mm	129.5	126.5	60	60
width b	mm	51	51	30	30
height h	mm	67	67.5	33.5	33.5
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+130	+130	+130	+130
temperature compensation		x	x	x	x

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducers:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
 pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

## Shear Wave Transducers (extended temperature range)

technical type		GDM2EZ7	GDP2EZ7
order code		<b>GSM-ENNNL</b>	<b>GSP-ENNNL</b>
transducer frequency	MHz	1	2
<b>medium pressure<sup>1</sup></b>			
min. extended min.	bar bar	metal pipe: 20 metal pipe: 30 plastic pipe: 1	metal pipe: 20 metal pipe: 30 plastic pipe: 1
<b>inner pipe diameter d<sup>2</sup></b>			
min. extended	mm	30	15
min. recommended	mm	40	20
max. recommended	mm	80	40
max. extended	mm	120	60
<b>pipe wall thickness</b>			
min.	mm	2.5	1.5
max.	mm	-	-
<b>material</b>			
housing		PI with stainless steel cap 304 (1.4301)	PI with stainless steel cap 304 (1.4301)
contact surface		PI	PI
degree of protection according to EN 60529		IP 65	IP 65
<b>transducer cable</b>			
type		6111	6111
length	m	4	4
<b>dimensions</b>			
length l	mm	62.5	62.5
width b	mm	32	32
height h	mm	40.5	40.5
dimensional drawing			
<b>operating temperature</b>			
min.	°C	-30	-30
max.	°C	+200	+200
temperature compensation		x	x

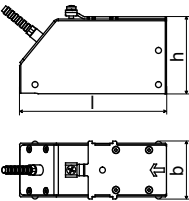
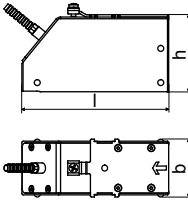
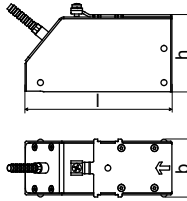
<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducers:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request

pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

## Lamb Wave Transducers

technical type		GRG1NC3	GRH1NC3	GRK1NC3
order code		GLG-NNNNL	GLH-NNNNL	GLK-NNNNL
transducer frequency	MHz	0.2	0.3	0.5
<b>medium pressure<sup>1</sup></b>				
min. extended	bar	metal pipe: 10	metal pipe: 10	metal pipe: 10 (d > 120 mm) 5 (d < 120 mm)
min.	bar	metal pipe: 15 plastic pipe: 1	metal pipe: 15 plastic pipe: 1	metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1
<b>inner pipe diameter d<sup>2</sup></b>				
min. extended	mm	190	120	60
min. recommended	mm	220	140	80
max. recommended	mm	900	600	300
max. extended	mm	1600	1000	500
<b>pipe wall thickness</b>				
min.	mm	11	7	4
max.	mm	23	15	9
<b>material</b>				
housing		PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 65	IP 65	IP 65
<b>transducer cable</b>				
type		1699	1699	1699
length	m	5	5	5
<b>dimensions</b>				
length l	mm	128.5	128.5	128.5
width b	mm	51	51	51
height h	mm	67.5	67.5	67.5
				
<b>operating temperature</b>				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

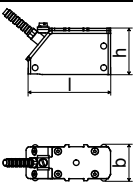
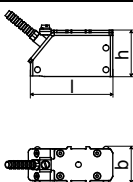
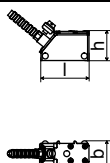
<sup>2</sup> Lamb wave transducers:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request

pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s

pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

## Lamb Wave Transducers

technical type		GRM1NC3	GRP1NC3	GRQ1NC3
order code		GLM-NNNNL	GLP-NNNNL	GLQ-NNNNL
transducer frequency	MHz	1	2	4
<b>medium pressure<sup>1</sup></b>				
min. extended min.	bar bar	- metal pipe: 10 (d > 60 mm) 5 (d < 60 mm) plastic pipe: 1	- metal pipe: 10 (d > 35 mm) 5 (d < 35 mm) plastic pipe: 1	- metal pipe: 10 (d > 15 mm) 5 (d < 15 mm) plastic pipe: 1
<b>inner pipe diameter d<sup>2</sup></b>				
min. extended	mm	30	15	7
min. recommended	mm	40	20	10
max. recommended	mm	90	50	22
max. extended	mm	150	70	35
<b>pipe wall thickness</b>				
min.	mm	2	1	0.5
max.	mm	5	3	1
<b>material</b>				
housing		PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 65	IP 65	IP 65
<b>transducer cable</b>				
type		1699	1699	1699
length	m	4	4	3
<b>dimensions</b>				
length l	mm	74	74	42
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
<b>operating temperature</b>				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x
remark				on request

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

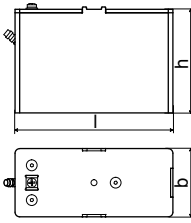
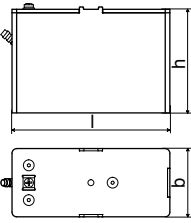
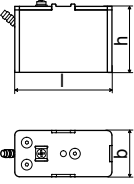
<sup>2</sup> Lamb wave transducers:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request

pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s

pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

## Shear Wave Transducers (zone 1)

technical type		GDG1NW1	GLG1NW1	GDK1NW1	GLK1NW1	GDM2NW1	GLM2NW1
order code		GSG-NA1NL	GSG-NA1NL/LC	GSK-NA1NL	GSK-NA1NL/LC	GSM-NA1NL	GSM-NA1NL/LC
transducer frequency	MHz	0.2		0.5		1	
medium pressure <sup>1</sup>							
min. extended min.	bar bar	metal pipe: 20 metal pipe: 30 plastic pipe: 1		metal pipe: 20 metal pipe: 30 plastic pipe: 1		metal pipe: 20 metal pipe: 30 plastic pipe: 1	
inner pipe diameter d							
min. extended	mm	250		70		30	
min. recommended	mm	380		80		40	
max. recommended	mm	810		500		80	
max. extended	mm	1100		720		120	
pipe wall thickness							
min.	mm	14		5		2.5	
max.	mm	-		-		-	
material							
housing		PEEK with stainless steel cap and transducer shoe 304 (1.4301)		PEEK with stainless steel cap and transducer shoe 304 (1.4301)		PEEK with stainless steel cap and transducer shoe 304 (1.4301)	
contact surface		PEEK		PEEK		PEEK	
degree of protection according to IEC/EN 60529		IP65		IP65		IP65	
transducer cable							
type		1699	1699	1699	1699	1699	1699
length	m	5	9	5	9	4	9
dimensions							
length l	mm	136.5		136.5		84	
width b	mm	59		59		40	
height h	mm	90.5		90.5		59	
dimensional drawing							
operating temperature							
min.	°C	-40		-40		-40	
max.	°C	+130		+130		+130	
temperature compensation		x		x		x	

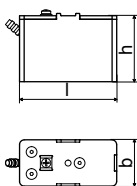
technical type			GDG1NW1	GLG1NW1	GDK1NW1	GLK1NW1	GDM2NW1	GLM2NW1
explosion protection								
A T E X	transducer		GSG- NA1NL	GSG- NA1NL/LC	GSK- NA1NL	GSK- NA1NL/LC	GSM- NA1NL	GSM- NA1NL/LC
	category		gas: 2/3G	dust: 2D	gas: 2/3G	dust: 2D	gas: 2/3G	dust: 2D
	EPL		Gb/Gc	Db	Gb/Gc	Db	Gb/Gc	Db
	zone		1/2	21	1/2	21	1/2	21
	explosion protection temperature (pipe surface)							
	min.	°C	-55		-55		-55	
	max.	°C	+180		+180		+180	
	marking		CE 0637 Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		CE 0637 Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		CE 0637 Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX	
	certification		IBExU10ATEX1162 X		IBExU10ATEX1162 X		IBExU10ATEX1162 X	
	type of protec- tion		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure	
	necessary transducer mounting fixture		-		-		-	

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducer:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a  
flow velocity of 15 m/s

## Shear Wave Transducers (zone 1)

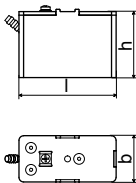
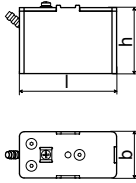
technical type		GDP2NW1	GLP2NW1
order code		GSP-NA1NL	GSP-NA1NL/LC
transducer frequency	MHz	2	
medium pressure <sup>1</sup>			
min. extended min.	bar bar	metal pipe: 20 metal pipe: 30 plastic pipe: 1	
inner pipe diameter d			
min. extended	mm	15	
min. recommended	mm	20	
max. recommended	mm	40	
max. extended	mm	60	
pipe wall thickness			
min.	mm	1.5	
max.	mm	-	
material			
housing		PEEK with stainless steel cap and transducer shoe 304 (1.4301)	
contact surface		PEEK	
degree of protection according to IEC/ EN 60529		IP65	
transducer cable			
type		1699	1699
length	m	4	9
dimensions			
length l	mm	84	
width b	mm	40	
height h	mm	59	
dimensional drawing			
operating temperature			
min.	°C	-40	
max.	°C	+130	
temperature compensation		x	

technical type		GDP2NW1	GLP2NW1
explosion protection			
A T E X	transducer		GSP-NA1NL GSP-NA1NL/LC
	category		gas: 2/3G dust: 2D
	EPL		Gb/Gc Db
	zone		1/2 21
	explosion protection temperature (pipe surface)		
	min.	°C	-55
	max.	°C	+180
	marking		CE 0637 Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX
	certification		IBExU10ATEX1162 X
	type of protection		gas: powder filling, non sparking dust: protection by enclosure
	necessary trans- ducer mounting fixture		-

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducer:  
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a  
flow velocity of 15 m/s

## Shear Wave Transducers (zone 1, extended temperature range)

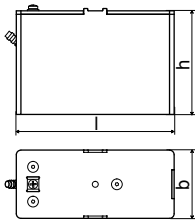
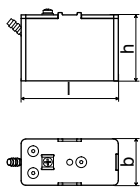
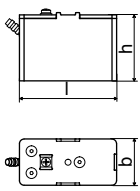
technical type		GDM2EW5	GLM2EW5	GDP2EW5	GLP2EW5
order code		GSM-EA1NL	GSM-EA1NL/LC	GSP-EA1NL	GSP-EA1NL/LC
transducer frequency	MHz	1		2	
medium pressure <sup>1</sup>					
min. extended min.	bar bar	metal pipe: 20 metal pipe: 30 plastic pipe: 1		metal pipe: 20 metal pipe: 30 plastic pipe: 1	
inner pipe diameter d					
min. extended	mm	30		15	
min. recommended	mm	40		20	
max. recommended	mm	80		40	
max. extended	mm	120		60	
pipe wall thickness					
min. max.	mm mm	2.5 -		1.5 -	
material					
housing		PI with stainless steel cap and transducer shoe 304 (1.4301)		PI with stainless steel cap and transducer shoe 304 (1.4301)	
contact surface		PI		PI	
degree of protection according to IEC/ EN 60529		IP56		IP56	
transducer cable					
type length	m	6111 4	6111 9	6111 4	6111 9
dimensions					
length l	mm	84		84	
width b	mm	40		40	
height h	mm	59		59	
dimensional drawing					
operating temperature					
min. max.	°C °C	-30 +200		-30 +200	
temperature compensation		x		x	





technical type			GDM2EW5	GLM2EW5	GDP2EW5	GLP2EW5	
explosion protection							
ATEX	transducer		GSM-EA1NL		GSM-EA1NL/LC	GSP-EA1NL	GSP-EA1NL/LC
	category		gas: 2/3G dust: 2D		gas: 2/3G dust: 2D		
	EPL		Gb/Gc Db		Gb/Gc Db		
	zone		1/2 21		1/2 21		
	explosion protection temperature (pipe surface)						
	min.	°C	-45		-45		
	max.	°C	+225		+225		
	marking		CE 0637 Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIA TX		CE 0637 Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIA TX		
	certification		IBExU10ATEX1162 X		IBExU10ATEX1162 X		
	type of protection		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure		
	necessary transducer mounting fixture		-		-		

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducer:  
 typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
 pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a  
 flow velocity of 15 m/s

## Shear Wave Transducers (zone 2)

technical type		GDG1NH1	GDK1NH1	GDM2NH1	GDP2NH1
order code		GSG-NA2NL	GSK-NA2NL	GSM-NA2NL	GSP-NA2NL
transducer frequency	MHz	0.2	0.5	1	2
medium pressure <sup>1</sup>					
min. extended min.	bar bar	metal pipe: 20 metal pipe: 30 plastic pipe: 1	metal pipe: 20 metal pipe: 30 plastic pipe: 1	metal pipe: 20 metal pipe: 30 plastic pipe: 1	metal pipe: 20 metal pipe: 30 plastic pipe: 1
inner pipe diameter d					
min. extended	mm	250	70	30	15
min. recommended	mm	380	80	40	20
max. recommended	mm	810	500	80	40
max. extended	mm	1100	720	120	60
pipe wall thickness					
min.	mm	14	5	2.5	1.5
max.	mm	-	-	-	-
material					
housing		PEEK with stainless steel cap and transducer shoe 304 (1.4301)	PEEK with stainless steel cap and transducer shoe 304 (1.4301)	PEEK with stainless steel cap and transducer shoe 304 (1.4301)	PEEK with stainless steel cap and transducer shoe 304 (1.4301)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection according to IEC/ EN 60529		IP65	IP65	IP65	IP65
transducer cable					
type		1699	1699	1699	1699
length	m	5	5	4	4
dimensions					
length l	mm	136.5	136.5	84	84
width b	mm	59	59	40	40
height h	mm	90.5	90.5	59	59
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+130	+130	+130	+130
temperature compensation		x	x	x	x

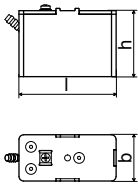
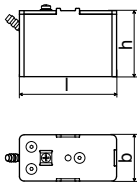
technical type		GDG1NH1	GDK1NH1	GDM2NH1	GDP2NH1
<b>explosion protection</b>					
<b>A T E X</b>	transducer	<b>GSG-NA2NL</b>	<b>GSK-NA2NL</b>	<b>GSM-NA2NL</b>	<b>GSP-NA2NL</b>
	category	gas: 3G dust: 2D	gas: 3G dust: 2D	gas: 3G dust: 2D	gas: 3G dust: 2D
	EPL	Gc	Db	Gc	Db
	zone	2	21	2	21
	<b>explosion protection temperature (pipe surface)</b>				
	min.	°C -55	°C -55	°C -55	°C -55
	max.	°C +190	°C +190	°C +190	°C +190
<b>A T E X</b>	marking	<b>CE 0637</b>  II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	<b>CE 0637</b>  II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	<b>CE 0637</b>  II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	<b>CE 0637</b>  II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db
	certification	IBExU10ATEX1 163 X	IBExU10ATEX1 163 X	IBExU10ATEX1 163 X	IBExU10ATEX1 163 X
	type of protection	gas: non spar- king dust: protection by enclosure	gas: non spar- king dust: protection by enclosure	gas: non spar- king dust: protection by enclosure	gas: non spar- king dust: protection by enclosure
	necessary trans- ducer mounting fixture	-	-	-	-

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducer:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
 pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a  
 flow velocity of 15 m/s

## Shear Wave Transducers (zone 2, extended temperature range)

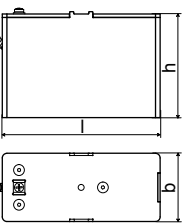
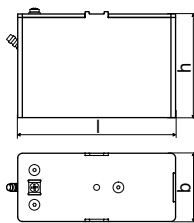
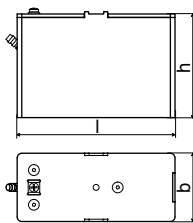
technical type		GDM2EH5	GDP2EH5
order code		GSM-EA2NL	GSP-EA2NL
transducer frequency	MHz	1	2
<b>medium pressure<sup>1</sup></b>			
min. extended min.	bar bar	metal pipe: 20 metal pipe: 30 plastic pipe: 1	metal pipe: 20 metal pipe: 30 plastic pipe: 1
<b>inner pipe diameter d</b>			
min. extended	mm	30	15
min. recommended	mm	40	20
max. recommended	mm	80	40
max. extended	mm	120	60
<b>pipe wall thickness</b>			
min.	mm	2.5	1.5
max.	mm	-	-
<b>material</b>			
housing		PI with stainless steel cap and transducer shoe 304 (1.4301)	PI with stainless steel cap and transducer shoe 304 (1.4301)
contact surface		PI	PI
degree of protection according to IEC/ EN 60529		IP56	IP56
<b>transducer cable</b>			
type		6111	6111
length	m	4	4
<b>dimensions</b>			
length l	mm	84	84
width b	mm	40	40
height h	mm	59	59
dimensional drawing			
<b>operating temperature</b>			
min.	°C	-30	-30
max.	°C	+200	+200
temperature compensation		x	x

technical type		GDM2EH5	GDP2EH5
explosion protection			
A T E X	transducer	<b>GSM-EA2NL</b>	<b>GSP-EA2NL</b>
	category	gas: 3G      dust: 2D	gas: 3G      dust: 2D
	EPL	Gc              Db	Gc              Db
	zone	2                21	2                21
	explosion protection temperature (pipe surface)		
	min.	°C      -45	-45
	max.	°C      +235	+235
	marking	CE 0637 Ex nA IIC T6...T2 Gc X II2D Ex tb IIIA TX Db	CE 0637 Ex nA IIC T6...T2 Gc X II2D Ex tb IIIA TX Db
	certification	IBExU10ATEX1163 X	IBExU10ATEX1163 X
	type of protection	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture	-	-

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducer:  
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

## Lamb Wave Transducers (zone 1)

technical type		GRG1NW3	GTG1NW3	GRH1NW3	GTH1NW3	GRK1NW3	GTK1NW3
order code		GLG-NA1NL	GLG-NA1NL/LC	GLH-NA1NL	GLH-NA1NL/LC	GLK-NA1NL	GLK-NA1NL/LC
transducer frequency	MHz	0.2		0.3		0.5	
medium pressure <sup>1</sup>							
min. extended	bar	metal pipe: 10		metal pipe: 10		metal pipe: 10 (d > 120 mm), 5 (d < 120 mm)	
min.	bar	metal pipe: 15 plastic pipe: 1		metal pipe: 15 plastic pipe: 1		metal pipe: 15 (d > 120 mm), 10 (d < 120 mm) plastic pipe: 1	
inner pipe diameter d							
min. extended	mm	190		120		60	
min. recom- mended	mm	220		140		80	
max. recom- mended	mm	900		600		300	
max. extended	mm	1600		1000		500	
pipe wall thickness							
min.	mm	11		7		4	
max.	mm	23		15		9	
material							
housing		PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU		PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU		PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU	
contact surface							
degree of protec- tion according to IEC/EN 60529		IP65		IP65		IP65	
transducer cable							
type		1699	1699	1699	1699	1699	1699
length	m	5	9	5	9	5	9
dimensions							
length l	mm	136.5		136.5		136.5	
width b	mm	59		59		59	
height h	mm	90.5		90.5		90.5	
dimensional draw- ing							
operating temperature							
min.	°C	-40		-40		-40	
max.	°C	+170		+170		+170	
temperature compensation		x		x		x	

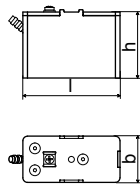
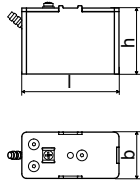
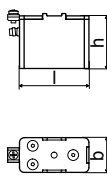
technical type		GRG1NW3	GTG1NW3	GRH1NW3	GTH1NW3	GRK1NW3	GTK1NW3
explosion protection							
A T T E N T I O N	transducer	GLG- NA1NL	GLG- NA1NL/LC	GLH- NA1NL	GLH- NA1NL/LC	GLK- NA1NL	GLK- NA1NL/LC
	category	gas: 2/3G	dust: 2D	gas: 2/3G	dust: 2D	gas: 2/3G	dust: 2D
	EPL	Gb/Gc	Db	Gb/Gc	Db	Gb/Gc	Db
	zone	1/2	21	1/2	21	1/2	21
	explosion protection temperature (pipe surface)						
	min. max.	°C	-55 +140	°C	-55 +140	°C	-55 +140
A T T E N T I O N	marking	<b>CE</b> 0637 <sup>(Ex)</sup> II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		<b>CE</b> 0637 <sup>(Ex)</sup> II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		<b>CE</b> 0637 <sup>(Ex)</sup> II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX	
	certification	IBExU10ATEX1162 X		IBExU10ATEX1162 X		IBExU10ATEX1162 X	
	type of protection	gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure	
	necessary transducer mounting fixture	-		-		-	

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> Lamb wave transducer:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
 pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s  
 pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

## Lamb Wave Transducers (zone 1)

technical type		GRM1NW3	GTM1NW3	GRP1NW3	GTP1NW3	GRQ1NW3	GTQ1NW3
order code		GLM-NA1NL	GLM-NA1NL/LC	GLP-NA1NL	GLP-NA1NL/LC	GLQ-NA1NL	GLQ-NA1NL/LC
transducer frequency	MHz	1		2		4	
medium pressure <sup>1</sup>							
min. extended min.	bar bar	- metal pipe: 10 (d > 60 mm), 5 (d < 60 mm) plastic pipe: 1		- metal pipe: 10 (d > 35 mm), 5 (d < 35 mm) plastic pipe: 1		- metal pipe: 10 (d > 15 mm), 5 (d < 15 mm) plastic pipe: 1	
inner pipe diameter d							
min. extended	mm	30		15		7	
min. recommended	mm	40		20		10	
max. recommended	mm	90		50		22	
max. extended	mm	150		70		35	
pipe wall thickness							
min.	mm	2		1		0.5	
max.	mm	5		3		1	
material							
housing		PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU		PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU		PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU	
contact surface		IP65		IP65		IP65	
degree of protection according to IEC/EN 60529		IP65		IP65		IP65	
transducer cable							
type		1699	1699	1699	1699	1699	1699
length	m	4	9	4	9	4	9
dimensions							
length l	mm	84		84		70	
width b	mm	40		40		30	
height h	mm	59		59		47.5	
dimensional drawing							
operating temperature							
min.	°C	-40		-40		-40	
max.	°C	+170		+170		+170	
temperature compensation		x		x		x	

technical type		GRM1NW3	GTM1NW3	GRP1NW3	GTP1NW3	GRQ1NW3	GTQ1NW3
explosion protection							
A T E X	transducer						
		<b>GLM-NA1NL</b>	<b>GLM-NA1NL/LC</b>	<b>GLP-NA1NL</b>	<b>GLP-NA1NL/LC</b>	<b>GLQ-NA1NL</b>	<b>GLQ-NA1NL/LC</b>
	category	gas: 2/3G	dust: 2D	gas: 2/3G	dust: 2D	gas: 2/3G	dust: 2D
	EPL	Gb/Gc	Db	Gb/Gc	Db	Gb/Gc	Db
	zone	1/2	21	1/2	21	1/2	21
	explosion protection temperature (pipe surface)						
	min.	°C	-55	-55	-55	-55	-55
	max.	°C	+140	+140	+140	+140	+140
	marking	<b>CE</b> 0637 <sup>(Ex)</sup> II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		<b>CE</b> 0637 <sup>(Ex)</sup> II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		<b>CE</b> 0637 <sup>(Ex)</sup> II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX	
	certification	IBExU10ATEX1162 X		IBExU10ATEX1162 X		IBExU10ATEX1162 X	
	type of protection	gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure	
	necessary transducer mounting fixture	-		-		-	
remark						on request	

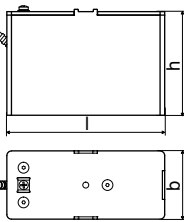
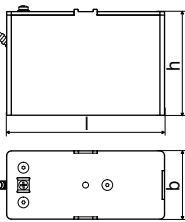
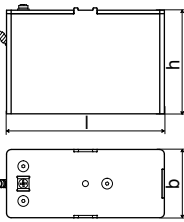
<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> Lamb wave transducer:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
 pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s

pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

## Lamb Wave Transducers (zone 2)

technical type		GRG1NH3	GRH1NH3	GRK1NH3
order code		<b>GLG-NA2NL</b>	<b>GLH-NA2NL</b>	<b>GLK-NA2NL</b>
transducer frequency	MHz	0.2	0.3	0.5
<b>medium pressure<sup>1</sup></b>				
min. extended	bar	metal pipe: 10	metal pipe: 10	metal pipe: 10 (d > 120 mm) 5 (d < 120 mm)
min.	bar	metal pipe: 15 plastic pipe: 1	metal pipe: 15 plastic pipe: 1	metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1
<b>inner pipe diameter d</b>				
min. extended	mm	190	120	60
min. recommended	mm	220	140	80
max. recommended	mm	900	600	300
max. extended	mm	1600	1000	500
<b>pipe wall thickness</b>				
min.	mm	11	7	4
max.	mm	23	15	9
<b>material</b>				
housing		PPSU with stainless steel cap and transducer shoe 304 (1.4301)	PPSU with stainless steel cap and transducer shoe 304 (1.4301)	PPSU with stainless steel cap and transducer shoe 304 (1.4301)
contact surface		PPSU	PPSU	PPSU
degree of protection according to IEC/ EN 60529		IP65	IP65	IP65
<b>transducer cable</b>				
type		1699	1699	1699
length	m	5	5	5
<b>dimensions</b>				
length l	mm	136.5	136.5	136.5
width b	mm	59	59	59
height h	mm	90.5	90.5	90.5
dimensional drawing				
<b>operating temperature</b>				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

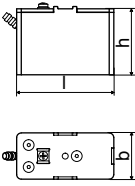
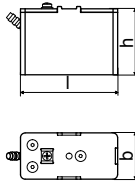
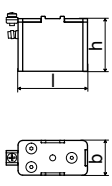
technical type		GRG1NH3		GRH1NH3		GRK1NH3		
explosion protection								
A T E X	transducer		GLG-NA2NL		GLH-NA2NL		GLK-NA2NL	
	category		gas: 3G dust: 2D		gas: 3G dust: 2D		gas: 3G dust: 2D	
	EPL		Gc Db		Gc Db		Gc Db	
	zone		2 21		2 21		2 21	
	explosion protection temperature (pipe surface)							
	min.	°C	-55		-55		-55	
	max.	°C	+150		+150		+150	
	marking		CE 0637 Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db		CE 0637 Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db		CE 0637 Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	
	certification		IBExU10ATEX1163 X		IBExU10ATEX1163 X		IBExU10ATEX1163 X	
	type of protection		gas: non sparking dust: protection by enclosure		gas: non sparking dust: protection by enclosure		gas: non sparking dust: protection by enclosure	
necessary transducer mounting fixture		-		-		-		




<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> Lamb wave transducer:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
 pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s  
 pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

## Lamb Wave Transducers (zone 2)

technical type		GRM1NH3	GRP1NH3	GRQ1NH3
order code		GLM-NA2NL	GLP-NA2NL	GLQ-NA2NL
transducer frequency		MHz 1	2	4
medium pressure <sup>1</sup>				
min. extended min.	bar bar	- metal pipe: 10 (d > 60 mm) 5 (d < 60 mm) plastic pipe: 1	- metal pipe: 10 (d > 35 mm) 5 (d < 35 mm) plastic pipe: 1	- metal pipe: 10 (d > 15 mm) 5 (d < 15 mm) plastic pipe: 1
inner pipe diameter d				
min. extended	mm	30	15	7
min. recommended	mm	40	20	10
max. recommended	mm	90	50	22
max. extended	mm	150	70	35
pipe wall thickness				
min.	mm	2	1	0.5
max.	mm	5	3	1
material				
housing		PPSU with stainless steel cap and transducer shoe 304 (1.4301)	PPSU with stainless steel cap and transducer shoe 304 (1.4301)	PPSU with stainless steel cap and transducer shoe 304 (1.4301)
contact surface		PPSU	PPSU	PPSU
degree of protection according to IEC/ EN 60529		IP65	IP65	IP65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	84	84	70
width b	mm	40	40	30
height h	mm	59	59	47.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

technical type		GRM1NH3	GRP1NH3	GRQ1NH3
<b>explosion protection</b>				
<b>A T E X</b>	transducer	<b>GLM-NA1NL</b>	<b>GLP-NA1NL</b>	<b>GLQ-NA1NL</b>
	category	gas: 3G dust: 2D	gas: 3G dust: 2D	gas: 3G dust: 2D
	EPL	Gc Db	Gc Db	Gc Db
	zone	2 21	2 21	2 21
	<b>explosion protection temperature (pipe surface)</b>			
	min.	°C -55	°C -55	°C -55
	max.	°C +150	°C +150	°C +150
<b>A T E X</b>	marking	<b>CE 0637</b>  II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	<b>CE 0637</b>  II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	<b>CE 0637</b>  II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db
	certification	IBExU10ATEX1163 X	IBExU10ATEX1163 X	IBExU10ATEX1163 X
	type of protection	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary trans- ducer mounting fixture	-	-	-
remark				on request

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> Lamb wave transducer:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request

pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s

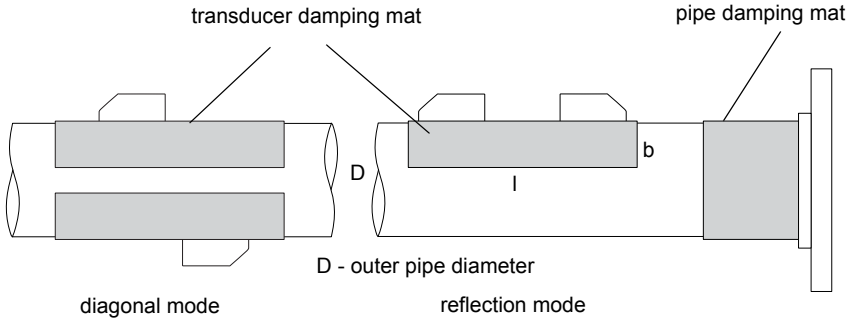
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Damping Mats (Optional)

Damping mats will be used for the gas measurement to reduce noise influences on the measurement.

**Transducer damping mats** will be installed below the transducers.

**Pipe damping mats** will be installed at reflection points, e.g. flange, welding.



Selection of Damping Mats

type	description	outer pipe diameter mm	dimensions l x b x h mm	transducer frequency					tempera- ture °C	remark	
				G	H	K	M	P			
transducer damping mat											
D	for temporary in- stallation (multiple use), fixed with coupling compound	< 80	450 x 115 x 0.5	-	-	-	x	x	-25...+60		
		≥ 80	900 x 230 x 0.5	-	-	x	x	-			
		900 x 230 x 1.3	x	x	-	-	-				
pipe damping mat											
A	for temporary in- stallation (multiple use), fixed with coupling compound	< 300	300 x 100 x 0.5	x	x	x	x	x	-25...+60	for num- ber of pieces see ta- ble below	
B	self-adhesive	≥ 300	l x 100 x 0.9	x	x	x	x	x	-35...+50	l - see table below	

Pipe Damping Mat Type A: Quantity Depending on the Outer Pipe Diameter

outer pipe diameter mm	number of pieces	
	for 1 reflexion point	for 2 reflexion points
100	4	7
200	7	13
300	10	19
500	16	32
1000	32	63

Pipe Damping Mat Type B: Length l Depending on Transducer Frequency and Outer Pipe Diameter

outer pipe diameter mm	transducer frequency	
	G, H	K, M, P
300	12 m	6 m
500	32 m	16 m
1000	126 m	63 m

# Units of Measurement

length/roughness	
unit of measurement	description
mm	millimeter
inch	inch

temperature	
unit of measurement	description
°C	degree Celsius
°F	degree Fahrenheit

pressure	
unit of measurement	description
bar (a)	bar (absolute)
bar (g)	bar (relative)
psi (a)	pounds per square inch (absolute)
psi (g)	pounds per square inch (relative)

density	
unit of measurement	description
g/cm <sup>3</sup>	gram per cubic centimeter
kg/cm <sup>3</sup>	kilogram per cubic centimeter

sound speed	
unit of measurement	description
m/s	meter per second

kinematic viscosity	
unit of measurement	description
mm <sup>2</sup> /s	square millimeter per second

$$1 \text{ mm}^2/\text{s} = 1 \text{ cSt}$$

flow velocity	
unit of measurement	description
m/s	meter per second
cm/s	centimeter per second
in/s	inches per second
fps (ft/s)	feet per second

standard/operational volumetric flow rate		volume (totalized)
unit of measurement	description	unit of measurement
m <sup>3</sup> /d	cubic meter per day	m <sup>3</sup>
m <sup>3</sup> /h	cubic meter per hour	m <sup>3</sup>
m <sup>3</sup> /min	cubic meter per minute	m <sup>3</sup>
m <sup>3</sup> /s	cubic meter per second	m <sup>3</sup>
ml/min	milliliter per minute	l or m <sup>3</sup>
l/h	liter per hour	l or m <sup>3</sup> *
l/min	liter per minute	l or m <sup>3</sup> *
l/s	liter per second	l or m <sup>3</sup> *
hl/h	hectoliter per hour	hl or m <sup>3</sup> *
hl/min	hectoliter per minute	hl or m <sup>3</sup> *
hl/s	hectoliter per second	hl or m <sup>3</sup> *
Ml/d (Megalit/d)	megaliter per day	Ml or m <sup>3</sup> *
bbl/d	barrels per day	bbl
bbl/h	barrels per hour	bbl
bbl/m	barrels per minute	bbl
USgpd (US-gal/d)	gallons per day	gal
USgph (US-gal/h)	gallons per hour	gal
USgpm (US-gal/m)	gallons per minute	gal
USgps (US-gal/s)	gallons per second	gal
KGPM (US-Kgal/m)	kilogallons per minute	kgal
MGD (US-Mgal/d)	million gallons per day	Mg
CFD	cubic feet per day	cft **
CFH	cubic feet per hour	cft
CFM	cubic feet per minute	cft
CFS	cubic feet per second	aft ***
MMCFD	million cubic feet per day	MMCF
MMCFH	million cubic feet per hour	MMCF

\* Selection with HotCode **007027**, firmware version V5.91 and higher

\*\* cft: cubic foot

\*\*\* aft: acre foot

1 US-gal = 3.78541 l

1 bbl = 42 US-gal = 158.9873 l

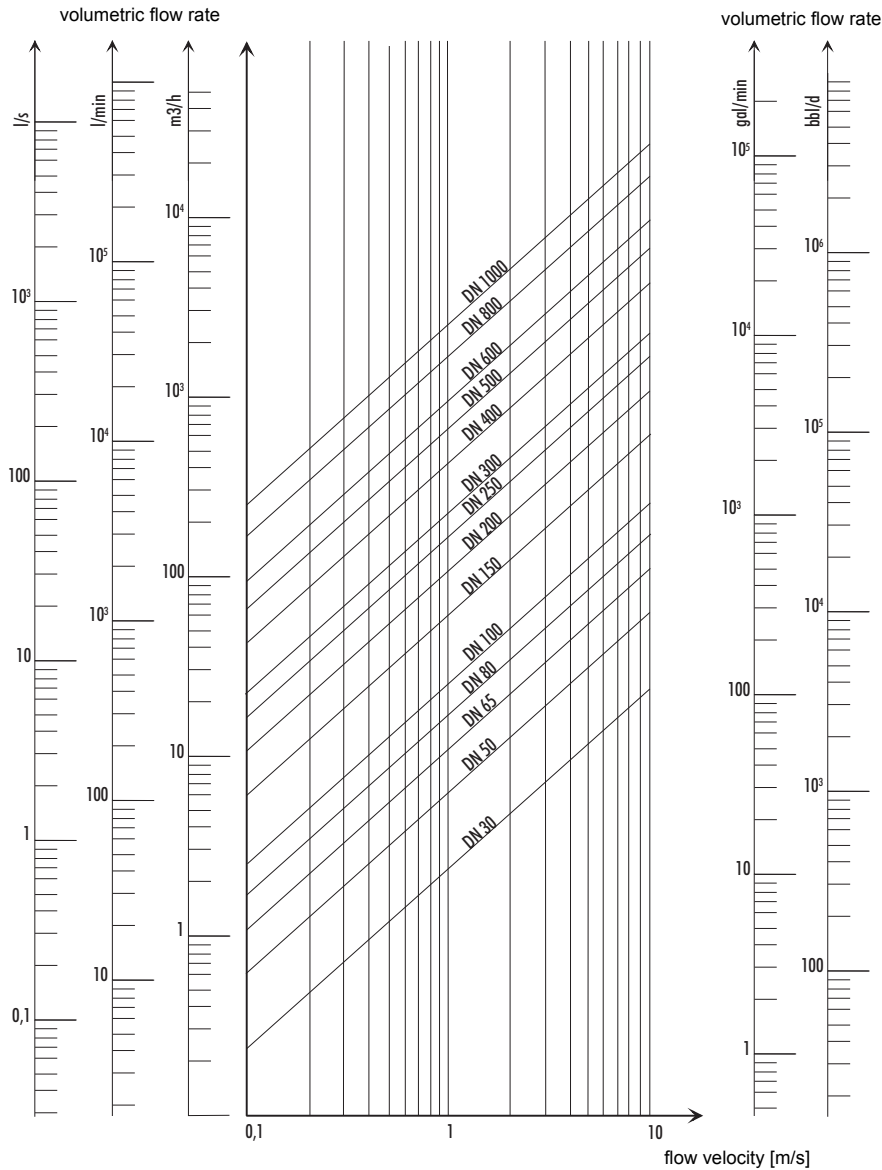
mass flow		mass (totalized)
unit of measurement	description	unit of measurement
t/h	ton per hour	t
t/d	ton per day	t
kg/h	kilogram per hour	kg
kg/min	kilogram per minute	kg
kg/s	kilogram per second	kg
g/s	gram per second	g

lb/d	pounds per day	lb
lb/h	pounds per hour	lb
lb/m	pounds per minute	lb
lb/s	pounds per second	lb
klb/h	kilopounds per hour	klb
klb/m	kilopounds per minute	klb

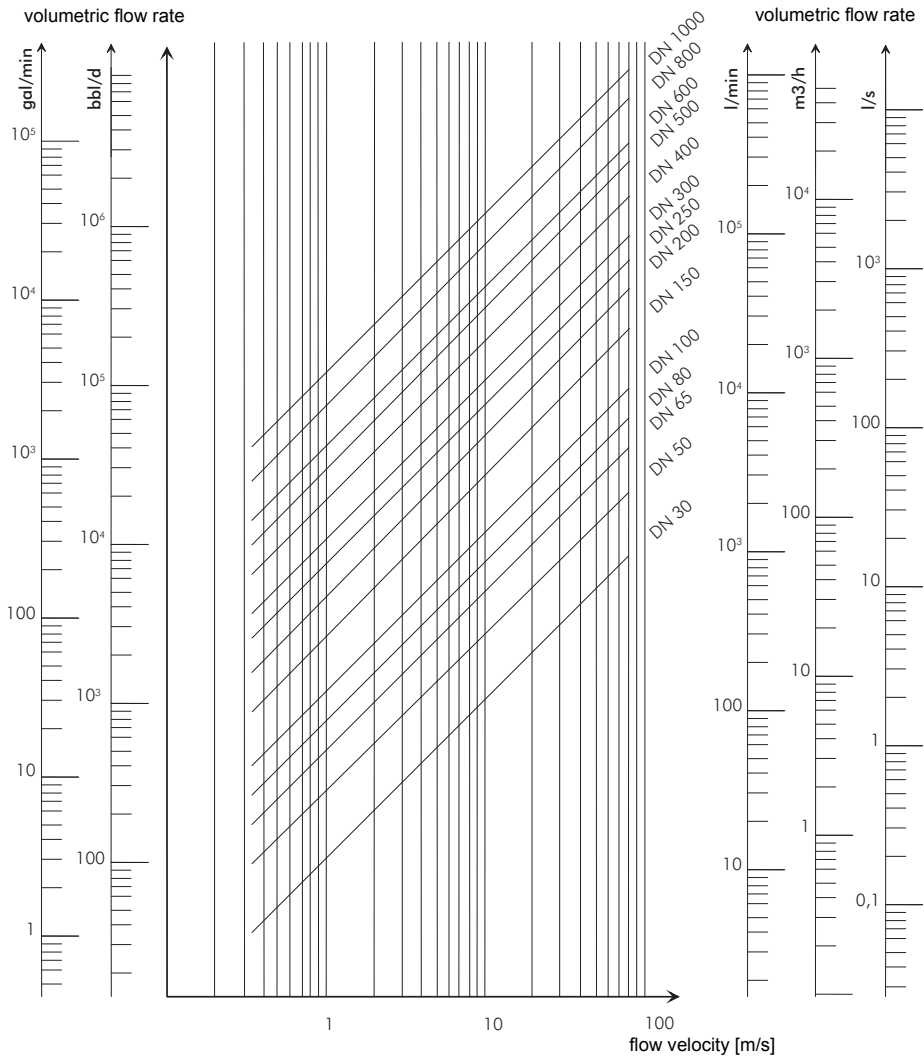
1 lb = 453.59237 g

1 t = 1000 kg

Flow Nomogram (Metrical)



Flow Nomogram (Imperial)



## C Reference

The following tables provide assistance for the user. The accuracy of the data depends on the composition, the temperature and the manufacturing process of the material. FLEXIM does not assume liability for any inaccuracies.

### C.1 Sound Speed of Selected Pipe and Lining Materials at 20 °C

The values of some of these materials are stored in the internal database of the transmitter. Column  $c_{\text{flow}}$  shows the sound speed (longitudinal or transversal) used for the flow measurement.

material	$c_{\text{trans}}$ [m/s]	$c_{\text{long}}$ [m/s]	$c_{\text{flow}}$	material	$c_{\text{trans}}$ [m/s]	$c_{\text{long}}$ [m/s]	$c_{\text{flow}}$
aluminum	3 100	6 300	trans	platinum	1 670		trans
asbestos cement	2 200		trans	polyethylene	925		trans
lead	700	2 200	trans	polystyrene	1 150		trans
bitumen	2 500		trans	PP	2 600		trans
brass	2 100	4 300	trans	PVC		2 395	long
carbon steel	3 230	5 800	trans	PVC (hard)	948		trans
copper	2 260	4 700	trans	PVDF	760	2 050	long
Cu-Ni-Fe	2 510		trans	quartz glass	3 515		trans
ductile iron	2 650		trans	rubber	1 900	2 400	trans
glass	3 400	4 700	trans	silver	1 590		trans
grey cast iron	2 650	4 600	trans	Sintimid		2 472	long
PE		1 950	long	stainless steel	3 230	5 790	trans
Perspex	1 250	2 730	long	Teka PEEK		2 537	long
PFA		1 185	long	Tekason		2 230	long
plastics	1 120	2 000	long	titanium	3 067	5 955	trans

The sound speed depends on the composition and the manufacturing process of the material.

The sound speed of alloys and cast materials fluctuates strongly. The values only serve as an orientation.

## C.2 Typical Roughnesses of Pipes

The values are based on experience and measurements.

material	absolute roughness [mm]
drawn pipes of non-ferrous metal, glass, plastics and light metal	0...0.0015
drawn steel pipes	0.01...0.05
fine-planed, polished surface	max. 0.01
planed surface	0.01...0.04
rough-planed surface	0.05...0.1
welded steel pipes, new	0.05...0.1
after long use, cleaned	0.15...0.2
moderately rusted, slightly encrusted	max. 0.4
heavily encrusted	max. 3
cast iron pipes:	
bitumen lining	> 0.12
new, without lining	0.25...1
rusted	1...1.5
encrusted	1.5...3

### C.3 Typical Properties of Selected Media at 20 °C and 1 bar

medium	sound speed [m/s]	kinematic viscosity [mm <sup>2</sup> /s]	density [g/cm <sup>3</sup> ]
acetone	1 190	0.4	0.7300
ammonia (NH <sub>3</sub> )	1 386	0.2	0.6130
gasoline	1 295	0.7	0.8800
beer	1 482	1.0	0.9980
BP Transcal LT	1 365	20.1	0.8760
BP Transcal N	1 365	94.3	0.8760
diesel	1 210	7.1	0.8260
natural gas	424	0.0	0.0000
ethanol	1 402	1.5	0.7950
hydrofluoric acid 50 %	1 221	1.0	0.9980
hydrofluoric acid 80 %	777	1.0	0.9980
glycol	1 665	18.6	1.1100
20 % glycol/H <sub>2</sub> O	1 655	1.7	1.0280
30 % glycol/H <sub>2</sub> O	1 672	2.2	1.0440
40 % glycol/H <sub>2</sub> O	1 688	3.3	1.0600
50 % glycol/H <sub>2</sub> O	1 705	4.1	1.0750
ISO VG 100	1 487	314.2	0.8690
ISO VG 150	1 487	539.0	0.8690
ISO VG 22	1 487	50.2	0.8690
ISO VG 220	1 487	811.1	0.8690
ISO VG 32	1 487	78.0	0.8690
ISO VG 46	1 487	126.7	0.8730
ISO VG 68	1 487	201.8	0.8750
methanol	1 119	0.7	0.7930
milk	1 482	5.0	1.00
Mobiltherm 594	1 365	7.5	0.8730
Mobiltherm 603	1 365	55.2	0.8590
NaOH 10 %	1 762	2.5	1.1140
NaOH 20 %	2 061	4.5	1.2230
paraffin 248	1 468	195.1	0.8450
R134 Freon	522	0.2	1.2400
R22 Freon	558	0.1	1.2130
crude oil, light	1 163	14.0	0.8130
crude oil, heavy	1 370	639.5	0.9220
sulphuric acid 30 %	1 526	1.4	1.1770
sulphuric acid 80 %	1 538	13.0	1.7950
sulphuric acid 96 %	1 366	11.5	1.8350
juice	1 482	1.0	0.9980
hydrochloric acid 25 %	1 504	1.0	1.1180
hydrochloric acid 37 %	1 511	1.0	1.1880
sea water	1 522	1.0	1.0240
Shell Thermina B	1 365	89.3	0.8630
silicone oil	1 019	14 746.6	0.9660
SKYDROL 500-B4	1 387	21.9	1.0570
SKYDROL 500-LD4	1 387	21.9	1.0570
Water	1 482	1.0	0.9990

## C.4 Properties of Methane

medium temperature [°C]	medium pressure [bar]	density [kg/m <sup>3</sup> ]	sound speed [m/s]	kinematic viscosity [mm <sup>2</sup> /s]	compressibility factor (AGA8-DC92) K
0	40	31.177	415.43	0.358693909	0.9062727
10		29.683	425.18	0.38628171	0.9182674
20		28.354	434.39	0.414403611	0.928556
30		27.159	443.13	0.44309437	0.9374469
40		26.076	451.46	0.472426753	0.9451792
50		25.09	459.43	0.502271821	0.9519414
60		24.186	467.08	0.532704871	0.9578844
70		23.353	474.44	0.563696313	0.9631301
80		22.583	481.54	0.595270779	0.9677784
0	80	68.928	411.41	0.184177693	0.819764
10		64.534	422.6	0.19880993	0.8446627
20		60.824	433.08	0.213649217	0.8656106
30		57.632	442.93	0.228709745	0.883441
40		54.841	452.23	0.24399628	0.8987615
50		52.372	461.06	0.259547086	0.9120284
60		50.164	469.47	0.275336895	0.9235928
70		48.174	477.51	0.291402001	0.9337303
80		46.367	485.22	0.307718852	0.9426606
0	120	111.81	429.84	0.134809051	0.7579655
10		103.24	438.35	0.144178613	0.7919381
20		96.221	447.12	0.153874934	0.8207028
30		90.346	455.84	0.163836805	0.8452495
40		85.332	464.39	0.174014438	0.8663576
50		80.984	472.7	0.184419145	0.8846352
60		77.166	480.75	0.195021123	0.90056
70		73.775	488.53	0.205828533	0.9145109
80		70.737	496.07	0.216831361	0.9267913

**D      Certificates**



## Declaration of conformity

We

FLEXIM Flexible Industriemesstechnik GmbH  
Wolfener Str. 36  
12681 Berlin  
Germany,

declare under our sole responsibility that the ultrasonic flowmeter

**FLUXUS G601**

to which this declaration relates is in conformity with the EC directives

**EMC Directive 2004/108/EC for Electromagnetic Compatibility**  
**Low Voltage Directive 2006/95/EC for Electrical Safety.**

The ultrasonic flowmeter is in conformity with the following European Standards:

Class	Standard	Description
EMC Directive	EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use - EMC requirements
- Immunity	EN 61326-1	Electrical equipment for continuous, unattended operation
	EN 61000-4-2:1995 +A1:1998+A2:2001	Testing and measurement techniques; Electrostatic Discharge Immunity
	EN 61000-4-3:2003	Testing and measurement techniques; RF Field Immunity
	EN 61000-4-4:2005	Testing and measurement techniques; Electrical Fast Transient / Burst Immunity
	EN 61000-4-5:2007	Testing and measurement techniques; Surge Immunity Test
	EN 61000-4-6:2002	Testing and measurement techniques; RF Conducted Immunity
	EN 61000-4-11:2005	Testing and measurement techniques; AC Mains Voltage Dips and Interruption Immunity
- Emission	EN 61326-1:2007	Electrical equipment Class A
Low Voltage Directive	EN 61010-1:2002	Safety requirements for electrical equipment for measurement, control and laboratory use

**The installation, operating and safety instructions have to be observed!**

Berlin, 29/04/2008

  
Dipl.-Ing. Jens Hilpert  
Managing Director





## Declaration of conformity

We,

**FLEXIM Flexible Industriemesstechnik GmbH**

**Wolfener Str. 36**

**12681 Berlin**

**Germany,**

declare under our sole responsibility that the transmitter

**FLUXUS \*608\*-A2**

to which this declaration relates is in conformity with the EC directives:

**EMC Directive 2004/108/EC for Electromagnetic Compatibility**

**Low Voltage Directive 2006/95/EC for Electrical Safety**

**Directive 94/9/EC - Safety Requirements for Control Systems  
and Equipment for Use in Explosive Atmospheres.**

The transmitter is in conformity with the following European Standards:

Class	Standard	Description
<b>EMC Directive</b>	EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use - EMC requirements
- Immunity	EN 61326-1	Electrical equipment for continuous, unattended operation
	EN 61000-4-2:1995 +A1:1998+A2:2001	Testing and measurement techniques; Electrostatic Discharge Immunity
	EN 61000-4-3:2003	Testing and measurement techniques; RF Field Immunity
	EN 61000-4-4:2005	Testing and measurement techniques; Electrical Fast Transient / Burst Immunity
	EN 61000-4-5:2007	Testing and measurement techniques; Surge Immunity Test
	EN 61000-4-6:2002	Testing and measurement techniques; RF Conducted Immunity
	EN 61000-4-11:2005	Testing and measurement techniques; AC Mains Voltage Dips and Interruption Immunity
- Emission	EN 61326-1:2007	Electrical equipment Class A
<b>Low Voltage Directive</b>	EN 61010-1:2002	Safety requirements for electrical equipment for measurement, control and laboratory use

(continuation on verso)

Class	Standard	Description
ATEX95	EN 60079-0:2009	Explosive atmospheres - Equipment - General requirements
	EN 60079-11:2007	Explosive atmospheres - Equipment protection by intrinsic safety "i"
	EN 60079-15:2010	Explosive atmospheres - Equipment protection by type of protection "n"
	EN 60079-31:2009	Explosive atmospheres - Equipment dust ignition protection by enclosure "t"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body  
IBExU Institut für Sicherheitstechnik GmbH  
(ID No. 0637):

Document type	Object	Document number
EC Type Examination Certificate	FLUXUS *608**-A2	IBExU10ATEX1067

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.  
The quality assurance system was certified by the notified body  
IBExU Institut für Sicherheitstechnik GmbH  
(ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transmitter includes the following:

transmitter without inputs:


CE 0637 Ex  
II 3G Ex nA nC ic IIC (T6) T4 Gc  
II 2D Ex tb IIC T 100 °C Db

transmitter with inputs:

CE 0637 Ex  
II 3G Ex nA nC [ic] IIC (T6) T4 Gc  
II 2D Ex tb IIC T 100 °C Db

**The installation, operating and safety instructions have to be observed!**

Berlin, 2011-03-25

  
Dipl.-Ing. Jens Hilpert  
Managing Director



## Declaration of conformity

We,

**FLEXIM Flexible Industriemesstechnik GmbH**

**Wolfener Str. 36**

**12681 Berlin**

**Germany,**

declare under our sole responsibility that

**the Power Adapter PA608A2 and**

**the Output Adapter OA608A2**

conform to the requirements for use in explosive atmosphere  
according to annex VIII of the

**Directive 94/9/EC - Safety Requirements for Control Systems  
and Equipment for Use in Explosive Atmospheres.**

The adapters mentioned above are in conformity with the following European Standards:

Class	Standard	Description
<b>ATEX95</b>	EN 60079-0:2009	Explosive atmospheres - Equipment - General requirements
	EN 60079-15:2010	Explosive atmospheres - Equipment protection by type of protection "n"

The marking of the adapters includes the following:



**IIG Ex nA IIC T6 Gc**

**Ta -20...+60 °C**

**The installation, operating and safety instructions have to be observed!**

Berlin, 2011-03-25

Dipl.-Ing. Jens Hilpert  
Managing Director





## Declaration of conformity

We,

**FLEXIM Flexible Industriemesstechnik GmbH**

**Wolfener Str. 36**

**12681 Berlin**

**Germany,**

declare under our sole responsibility that the transducers

**\*\*G1NW1, \*\*K1NW1, \*\*M2NW1, \*\*P2NW1, \*\*Q2NW1, \*\*G1NW3,  
\*\*H1NW3, \*\*K1NW3, \*\*M1NW3, \*\*P1NW3, \*\*Q1NW3**

are in conformity with the following EC directives:

**Directive 94/9/EC - Safety Requirements for Control Systems  
and Equipment for Use in Explosive Atmospheres.**

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2009	Explosive atmospheres - Equipment - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 60079-15:2010	Explosive atmospheres - Equipment protection by type of protection "n"
	EN 60079-31:2009	Explosive atmospheres - Equipment dust ignition protection by enclosure "I"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body

**IBExU Institut für Sicherheitstechnik GmbH**

(ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	<b>**G1NW1, **K1NW1, **M2NW1, **P2NW1, **Q2NW1, **G1NW3, **H1NW3, **K1NW3, **M1NW3, **P1NW3, **Q1NW3</b>	<b>IBExU10ATEX1162 X</b>

(continuation on verso)

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.

The quality assurance system was certified by the notified body

IBExU Institut für Sicherheitstechnik GmbH

(ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:



II2/3G Ex q nA IIC T6...T2 Gb/Gc

II2D Ex tb IIC TX

**The installation, operating and safety instructions have to be observed!**

Berlin, 2011-03-25

  
Dipl.-Ing. Jens Hilpert  
Managing Director



## Declaration of conformity

We,

**FLEXIM Flexible Industriemesstechnik GmbH**

**Wolfener Str. 36**

**12681 Berlin**

**Germany,**

declare under our sole responsibility that the transducers

**\*\*M2EW5, \*\*P2EW5, \*\*Q2EW5**

are in conformity with the following EC directives:

**Directive 94/9/EC - Safety Requirements for Control Systems  
and Equipment for Use in Explosive Atmospheres.**

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2009	Explosive atmospheres - Equipment - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 60079-15:2010	Explosive atmospheres - Equipment protection by type of protection "n"
	EN 60079-31:2009	Explosive atmospheres - Equipment dust ignition protection by enclosure "I"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body  
IBExU Institut für Sicherheitstechnik GmbH  
(ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	<b>**M2EW5, **P2EW5, **Q2EW5</b>	IBExU10ATEX1162 X

(continuation on verso)

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.

The quality assurance system was certified by the notified body

IBExU Institut für Sicherheitstechnik GmbH

(ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:



II2/3G Ex q nA IIC T6...T2 Gb/Gc

II2D Ex tb IIIA TX

**The installation, operating and safety instructions have to be observed!**

Berlin, 2011-03-25

Dipl.-Ing. Jens Hilpert  
Managing Director



## Declaration of conformity

We,

**FLEXIM Flexible Industriemesstechnik GmbH**

**Wolfener Str. 36**

**12681 Berlin**

**Germany,**

declare under our sole responsibility that the transducers

**\*\*G1NH1, \*\*K1NH1, \*\*M2NH1, \*\*P2NH1, \*\*Q2NH1, \*\*G1NH3, \*\*H1NH3,  
\*\*K1NH3, \*\*M1NH3, \*\*P1NH3, \*\*Q1NH3**

are in conformity with the following EC directives:

**Directive 94/9/EC - Safety Requirements for Control Systems  
and Equipment for Use in Explosive Atmospheres.**

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
<b>ATEX95</b>	EN 60079-0:2009	Explosive atmospheres - Equipment - General requirements
	EN 60079-15:2010	Explosive atmospheres - Equipment protection by type of protection "n"
	EN 60079-31:2009	Explosive atmospheres - Equipment dust ignition protection by enclosure "I"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body  
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	<b>**G1NH1, **K1NH1, **M2NH1, **P2NH1, **Q2NH1, **G1NH3, **H1NH3, **K1NH3, **M1NH3, **P1NH3, **Q1NH3</b>	<b>IBExU10ATEX1163 X</b>

(continuation on verso)

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.

The quality assurance system was certified by the notified body

IBExU Institut für Sicherheitstechnik GmbH

(ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:

CE 0637 Ex

II3G Ex nA IIC T6...T2 Gc X

II2D Ex Ib IIC TX Db

**The installation, operating and safety instructions have to be observed!**

Berlin, 2011-03-25

  
Dipl.-Ing. Jens Hilpert  
Managing Director



## Declaration of conformity

We,

**FLEXIM Flexible Industriemesstechnik GmbH**

**Wolfener Str. 36**

**12681 Berlin**

**Germany,**

declare under our sole responsibility that the transducers

**\*\*M2EH5, \*\*P2EH5, \*\*Q2EH5**

are in conformity with the following EC directives:

**Directive 94/9/EC - Safety Requirements for Control Systems  
and Equipment for Use in Explosive Atmospheres.**

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
<b>ATEX95</b>	EN 60079-0:2009	Explosive atmospheres - Equipment - General requirements
	EN 60079-15:2010	Explosive atmospheres - Equipment protection by type of protection "n"
	EN 60079-31:2009	Explosive atmospheres - Equipment dust ignition protection by enclosure "I"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body  
IBExU Institut für Sicherheitstechnik GmbH  
(ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	<b>**M2EH5, **P2EH5, **Q2EH5</b>	<b>IBExU10ATEX1163 X</b>

(continuation on verso)

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.

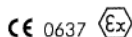
The quality assurance system was certified by the notified body

IBExU Institut für Sicherheitstechnik GmbH

(ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:




II3G Ex nA IIC T6...T2 Gc X

II2D Ex tb IIIA TX Db

**The installation, operating and safety instructions have to be observed!**

Berlin, 2011-03-25

  
Dipl.-Ing. Jens Hilpert  
Managing Director